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ALL,

A COURSE
OF
ELEMENTARY READING
IN
SCIENCE AND LITERATURE,
COMPILED FROM POPULAR WRITERS:

WITH
AN APPENDIX:
COMPRISING A VOCABULARY OF SCIENTIFIC TERMS, AND A LIST OF THE PREFIXES, AFFIXES, AND PRINCIPAL LATIN AND GREEK ROOTS OF THE ENGLISH LANGUAGE.

By J. M. M'CULLOCH, D.D.,
FORMERLY HEAD-MASTER OF CIRCUS PLACE SCHOOL, EDINBURGH,
Author of "A Manual of English Grammar," etc.

WITH THIRTY-NINE WOODCUTS.

RECAST AND ENLARGED.

FIFTY-THIRD EDITION.

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PREFACE

TO THE THIRTY-NINTH EDITION.

AFTER the lapse of upwards of thirty years from the date of its first publication, a Schoolbook, which bears the somewhat pretentious title of "A Course of Reading in Science and Literature," cannot but stand in need of many and very material alterations to keep its contents in harmony with the great advance in the subjects and methods of elementary education. Many topics, which were full of interest and instruction to schoolboys thirty years ago, have now become stale or obsolete; and several branches of knowledge, which were then rarely studied except in colleges, are now so popularized as to demand a place in ordinary schools.

An excusable reluctance to incommode Teachers by disturbing the text has perhaps too long restrained the Compiler from undertaking such necessary alterations. But it is the object of the present edition to readapt the Book to its title; and although the changes introduced amount to little short of an entire reconstruction of the Work, it is believed that no alterations on a less extensive scale would have sufficed to bring the whole contents into conformity with the progress of knowledge and the altered conditions of education.

As before, the greater part of the Book consists of lessons on Natural History and on the Physical Sciences. But in both departments extensive changes have been made, *in order to* render the lessons at once more consecutive and more comprehensive. In the former department, a general sketch of the Three Kingdoms of Nature is followed up by separate lessons on Minerals, Plants, and Animals; and in the latter, an introductory explanation of the various Physical Forces is succeeded by a graduated course of reading on Mechanics, Chemistry, Heat, Electricity, and Light. A Vocabulary of Scientific Terms has been added for the use both of teachers and of pupils. And, to ensure the greatest acquirable correctness, the whole of the lessons have been submitted to the revision of gentlemen eminent for their attainments in science.

Among the subjects introduced for the first time are a series of lessons on the phenomena of Industrial Life, and a series on Language and Literature. The lessons on Geography and Astronomy are also, to some extent, new. Those on the subject of Religion embrace a wider range than their predecessors. And the Miscellaneous lessons have been so modified as to supply a greater amount and variety of interesting and agreeable reading.

In the Poetical department, many pieces have been retrenched to make room for others of a later date; and, with the view of enabling the pupil to note and appreciate characteristic diversities of genius and style, specimens are given, in chronological order, of all our great poets from Spenser to Tennyson, along with examples of the manner in which the same subject is handled by different poets.

The Diagrams and other Pictorial Embellishments have been transferred from the Appendix to those parts of the text which they are designed to illustrate.

The copious List of Latin and Greek Roots, which has always formed a distinctive feature of the Book, has been carefully revised and somewhat enlarged.

Considering the number and variety of the topics embraced in the Work, it will scarcely be expected that any one of them should be *exhaustively* treated. Nor has this been aimed at. It is thought that the plan of furnishing the pupil with a complete synopsis of some particular science or sciences is less favourable to his mental progress than that which stimulates without forestalling his curiosity, by opening up to him broad and general views of the whole region of knowledge. Provided the information given him is exact and accurate so far as it goes, it does not seem necessary, at least during the earlier stages of his studies, that it should be also complete and minute. And as the design of all elementary teaching is rather to rouse and develop the mental powers than to store the mind with facts, so the Lesson-books best adapted to their end are those which serve to create in the pupil a taste and relish for further study, and to send him from school with the desire and purpose to press on towards higher attainments.

To the Writers whose names are appended to the various Lessons, some apology is perhaps due for the liberties which have very often been taken in abridging, simplifying, and otherwise altering their productions. But as these changes have been made solely for the purpose of adapting the selections to the practical business of education, or of bringing their statements into more strict accordance with recent discoveries, it is hoped that they are only such as the Authors themselves would have introduced had their design been to supply a Manual of Elementary Reading.

CONTENTS (CLASSIFIED).

Page
EXERCISES on the Inflections of the Voice,...... 12

I. NATURAL HISTORY.

The Three Kingdoms of Nature,...... *Compiled* 21
    I. Minerals,...... *Id.* 21
    II. Vegetables,...... *Id.* 22
    III. Animals,...... *Id.* 25
Rocks and their Arrangement,...... *Id.* 70
Organs and Functions of Plants,...... *Id.* 114
Leaves,...... *Id.* 118
The Seed,...... *Id.* 119
Germination,...... *British Quarterly Review* 120
Uses of Plants,...... *Id.* 122
Classification and Structure of Animals,...... *Compiled* 173
Circulation of the Blood,...... *Mrs Hack* 234
Process of Nutrition,...... *Compiled* 236
Parallel between Plants and Animals,...*British Quarterly Review* 307
Purpose of the Human Body,...... *Compiled* 351
The Senses,...... *Id.* 353
    Seeing,...... *Id.* 353
    Hearing,...... *Id.* 357
    Smelling,...... *Id.* 359
    Tasting,...... *Id.* 361
    Touch,...... *Id.* 362
The Phasis of Matter,...... *Kemp* 373

II. PHYSICAL SCIENCE.

The Pleasures of Science,...... *Brougham* 15
The Physical Forces,...... *Compiled chiefly from Faraday* 44
    Cohesion,...... *Id.* 45
    Gravitation,...... *Id.* 47
    Chemical Affinity,...... *Id.* 50
    Heat,...... *Id.* 52
    Electricity,...... Id. 53
    Magnetism,...... Id. 58

Page
Laws of Motion, ... *Compiled* 100
Machinery and its Uses,.. *Id.* 104
The Mechanical Powers,.. *Id.* 106
Pressure of Watery Fluids,.. *Brougham* 144
Elementary Bodies,.. *Fownes* 152
Combustion,.. *Gregory* 156
Compound Bodies and their Nomenclature,.. *Compiled* 158
Compound Bodies Continued,.. *Id.* 160
Laws of Elementary Combination,.. *Tulloch* 164
The Atmosphere,.. *Compiled* 199
Properties of Heat,.. *Turner* 217
    Radiation,.. *Id.* 217
    Conduction,.. *Id.* 218
Effects of Heat,.. *Id.* 219
    Expansion,.. *Id.* 219
    Liquefaction,.. *Id.* 220
    Vaporization,.. *Id.* 221
James Watt and the Steam-Engine,..... *British Quarterly Review* 229
The Winds,.. *Compiled* 250
Thunder-storms,.. *British Quarterly Review* 276
The Electric Telegraph,.. *Compiled* 285
Origin and Progress of the Electric Telegraph,.. *Id.* 290
Rain,.. *British Quarterly Review* 314
Clouds, Mists, Fog, Snow, Hail and Dew,.. *Compiled* 318
General Properties of Light,.. *Id.* 337
Composition of Light,.. *Id.* 341
Chemical Power of Light,.. *Id.* 344

III. GEOGRAPHY AND ASTRONOMY.

Rotundity of the Earth,.. *Malte-Brun* 38
Land and Water,.. *Compiled* 81
Surface of the Land,.. *Id.* 84
The Tides,.. *Id.* 135
The Gulf Stream,.. *British Quarterly Review* 137
Springs, Rivers, and Lakes, ... *Compiled* 184
Daily Revolution of the Celestial Sphere,.. *Id.* 203
The Moon and Stars: a Fable,.. *Montgomery* 208
Motions of the Earth, Moon, and Planets,.. 254
Vastness of the Universe,.. *Compiled* 377

IV. INDUSTRIAL ECONOMY.

Page
Terms used in Industrial Science, .*Compiled from Templar & Dawes* 87
Prices and their Fluctuations, ... *Id.* 140
Law of Wages, ... *Compiled* 193
Popular Errors respecting Industrial Laws, ... *Id.* 259
Strikes, ... *Templar* 328
Evils of Strikes, ... *Compiled* 331

V. LANGUAGE AND LITERATURE.

Language, ... *Compiled* 30
Books, and How to Read them, ... *Id.* 34
The Long Life of Books, ... *Willmott* 73
The Figures of Speech, ... 125
  1. Metaphor, Comparison, Allegory, ... 126
  2. Irony, Hyperbole, Interrogation, ... 127
  3. Antithesis and Climax, ... 128
  4. Ellipsis and Pleonasm, ... 129
  5. Personification, ... 130
  6. Apostrophe, ... 130
  7. Exclamation, ... 130
  8. Vision, ... 131
The English Language, ... *Compiled* 178
English Versification, ... *Willmott* 242
Hebrew Metre, ... 245
Rhetorical Extracts, ... 271
  Against the Employment of Indians in the American War, ... *Lord Chatham* 271
  British Freedom, ... *Curran* 272
  Marie Antoinette, ... *Burke* 273
  Law Reform, ... *Brougham* 274
  Death of Nelson, ... *Southey* 275
  Regret for the Dead, ... *Washington Irving* 276

VI. RELIGION.

Divine Truth, ... 40
Pardon of Sin the Free Gift of God, ... 96
Holiness as necessary to Salvation as Pardon, ... *Russell* 98
Beneficial Effects of the Gospel, ... 147
The Spread of the Gospel, ... 213

Page
Prophecy,..Burder 264
Self-Harmony of the Holy Scriptures,.................................. 268
Choice Passages from Eminent Preachers,.............................. 323
  Composure of Mind necessary to Prayer,......*Jeremy Taylor* 323
  Man's Intellect before the Fall,...............................*South* 324
  On the Threatened Invasion in 1803,..............*Robert Hall* 324
  The Negro Race,.....................................*Richard Watson* 326
  Man an object of Heavenly Sympathy,...............*Chalmers* 327
The Character of Christ,.. 370

VII. MISCELLANEOUS LESSONS.

Dignity and Achievements of Labour,...*Dewey*, *Parker*, *Newman Hall*, *Arnott*, *Longfellow* 19
The Vision of Mirza,...*Addison* 26
How it Strikes a Stranger,..................................*Jane Taylor* 64
Specimens of Descriptive Travel,.. 91
  The Pyramid of Gizeh,...........................*Dr E. D. Clarke* 91
  The Nile,...*Warburton* 92
  Pompeii,..*Anonymous* 93
  The Pampas,..*Sir F. Head* 94
Self-Help,..*Macmillan's Magazine* 111
The Great Mart,...*Mrs Barbauld* 169
Jerusalem,...*Conder* 189
The British Constitution,... 299
England Past and Present,...........*Carlyle*, *Coleridge*, *Macaulay*, *M'Diarmid*, *Gladstone* 301
Apophthegms,...................................*Sidney*, *Raleigh*, *etc. etc.* 309
A Public Meeting not reported in the Newspapers,.................. 364

VIII. POETRY.

God in Nature,..*Cowper*, *Moore* 17
The Burial of Sir John Moore,..................................*Wolfe* 29
The Nightingale,..*Milton*, *Coleridge* 37
Christology,...*Milton*, *Milman*, *Dale* 43
Quotations from Shakspeare,.. 61
Death,..........................*Mrs Hemans*, *Tennyson*, *Mrs Southey* 68
The Saxon and the Gael,..................................*Sir Walter Scott* 75
The Saxon and the Gael continued..................................... Id. 78

Page
The Alps, ... *Rogers* 86
To an Egyptian Mummy, ... *Horace Smith* 95
Quotations from Byron, ... 109
Yardley Oak, ... *Cowper* 124
Similes from the Poets, ... *Shakspeare, Milton, etc. etc.* 132
The Treasures of the Deep, ... *Mrs Hemans* 139
Wellington's Army in Portugal, ... *Sir Walter Scott* 146
The Cloud's Silver Lining, ... *Keble* 151
Quotations from Wordsworth, ... 167
Threnodies, ... *Milton, Pope, Gray, Mrs Hemans* 171
The Falls of Niagara, ... *Brainard* 187
The Cataract of Velino, ... *Byron* 188
Jerusalem before the Siege, ... *Milman* 192
Song of the Shirt, ... *Hood* 197
A Moonlight Night at Venice, ... *Byron* 212
Specimens of the Poetry of the Sixteenth and Seventeenth Centuries, *Raleigh, Spenser, Shakspeare, Jonson, Herbert, Milton, Butler, Dryden,* 224
Battle of the Baltic, ... *Campbell* 239
Waterloo, ... *Byron* 240
The Temple of Fame, ... *Pope* 248
A Sultry Day, ... *Bryant* 253
The Day of Judgment, ... *Heber, Whitehead, C. Wesley* 267
Shipwreck in a Calm, ... *Wilson* 283
Specimens of the Poetry of the Eighteenth Century, ... *Young, Pope, Thomson, Gray, Goldsmith, Darwin, Cowper, Jones* 294
Adversity, ... *Cowper, Southey, Bishop Wilberforce, Mackay* 304
The Cloud, ... *Shelley* 321
Arethusa, ... *Id.* 336
The Building of the Ship, ... *Longfellow* 347
Sonnets, ... *Milton, Wordsworth* 369
Specimens of the Poetry of the Nineteenth Century, ... *Rogers, Wordsworth, Scott, Coleridge, Southey, Campbell, Moore, Byron, Wilson, Macaulay, Tennyson* 380

APPENDIX.

I. Vocabulary of Scientific Terms, ... 387
II. Prefixes, Affixes, and Principal Latin and Greek Roots of the English Language, ... 403

EXERCISES ON THE INFLECTIONS OF THE VOICE.

THE voice, in reading, has two essential turns or inflections, the *rising* and the *falling*. The *rising* inflection is that upward turn of the voice which we generally use in asking a question beginning with a verb, and is marked with the acute accent (′). The *falling* inflection is that downward sliding of the voice which is commonly used at the end of a sentence, and is designated by the grave accent (`). These two inflections have been justly described as the axis on which the force, variety, and harmony of speaking turn.

EXAMPLES.

The Rising followed by the Falling.

Does he talk rationally′, or irrationally` ?
Does he pronounce correctly′, or incorrectly` ?
Does she dance gracefully′, or ungracefully` ?
Should we say humour′, or humour` ?
Should we say altar′, or altar` ?
Should we say airy′, or airy` ?

The Falling followed by the Rising.

He talks rationally`, not irrationally′.
He pronounces correctly`, not incorrectly′.
She dances gracefully`, not ungracefully′.
We should say humour`, not humour′.
We should say airy`, not airy′.

Many rules are given by Mr Walker and his followers for the inflecting of sentences or parts of sentences; but the following comprise all that are essential:—

I. AFFIRMATIVE SENTENCES.

1. Where the sense is complete, whether it be at the termination of a sentence or of a clause of a sentence, use the falling inflection.

2. In negative sentences, on the contrary, or negative members of sentences, use the rising inflection.

3. When sentences are divisible into two parts, the commencing *part is distinguished by the* rising inflection.

EXAMPLES.

1. It is to the unaccountable oblivion of our mortality, that the world owes all its fascination`.

You may lay it down as a maxim, confirmed by universal experience, that every man dies as he lives`; and it is by the general tenor of the life, not a particular frame of mind at the hour of death, that we are to be judged at the tribunal of God.

---

2. I cannot, I will not join in congratulation on misfortune and disgrace′.

It is not enough that you continue steadfast and immovable′—you must also abound in the work of the Lord, if you expect your labours to be crowned with success.

---

3. *If to do were as easy as to know what were good′ to do*—chapels had been churches, and poor men's cottages princes' palaces.

Your enemies may be formidable by their numbers, and by their power′, but He who is with you is mightier than they.

To all the charms of beauty, and the utmost elegance of external form′, Mary added those accomplishments which render their impression irresistible.

The only exception to these rules worthy of notice occurs in the case of antithetical sentences. When the commencing member of an antithesis is opposed in the concluding member by a negation, the latter has the rising, and the former the falling inflection—as in the following examples:—

We have taken up arms to defend` our country, not to betray it′.

The duty of a soldier is to obey`, not to direct his general′.

II. INTERROGATIVE SENTENCES.

1. Questions asked by pronouns generally end with the falling inflection.

2. Questions asked by verbs generally require the rising inflection.

3. When the question affects two objects, taken *disjunctively*, the former has the rising, and the latter the falling inflection.

EXAMPLES.

1. What evil can come nigh to him for whom Jesus` died?

2. Shall guilty and condemned creatures appear in the presence of Him, in whose sight the heavens are not clean, and who chargeth his angels with folly′?

3. Are you toiling for fame′, or for fortune`?

(1.) Who are the persons that are most apt to fall into peevish-
ness and dejection`? (3.) Are they the affluent′ or the indigent`?
(2.) Are *they those whom* want compels to toil for their daily meal
and nightly pillow′—who have no treasure, but the sweat of their

brows′—who rise with the rising sun, to expose themselves to all the rigours of the seasons, unsheltered from the winter's cold, and unshaded from the summer's heat′? No! the labours of such are the very blessings of their condition.

III. PARENTHESIS.

The general rule for the parenthesis is, that it must be pronounced in a lower tone and more rapidly than the rest of the sentence, and conclude with the inflection that immediately precedes it. A simile, being a species of parenthesis, follows the same rule.

EXAMPLES.

Notwithstanding all this care of Cicero, history informs us that Marcus proved a mere blockhead; and that na′ture (who, it seems, was even with the son for her prodigality to the fa′ther) rendered him incapable of improving, by all the rules of el`oquence, his own endeav`ours, and the most refined conversation in Ath`ens.

Like the ivy, false friendship rends and ruins the wall which it embraces; but true friendship gives new life and vigour to what it supports, as the stock of the apple tree feeds and fructifies the graft.

IV. ECHO.

The title Echo, Mr Walker has adopted to express a repetition of a word or phrase. The echoing word is pronounced with the rising inflection, and a considerable pause after it.

EXAMPLE.

Newton was a Christian! *New′ton!* whose mind burst forth from the fetters cast by nature on our finite conceptions—*New′ton!* who carried the line and rule to the utmost barriers of creation, and explored the principles by which, no doubt, all created matter is held together and exists.

A COURSE
OF
ELEMENTARY READING
IN
SCIENCE AND LITERATURE.

SECTION I.

THE PLEASURES OF SCIENCE.

It is easy to show that there is a positive gratification resulting from the study of the sciences.

If it be a pleasure to gratify curiosity—to know what we were ignorant of—to have our feelings of wonder called forth—how pure a delight of this very kind does natural science hold out to its students! Recollect some of its extraordinary discoveries. Is there anything in all the idle books of tales and horrors, with which youthful readers are so much delighted, more truly astonishing than the fact, that a few pounds of water may, without any machinery, by merely being placed in a particular way, produce an irresistible force? What can be more strange than that an ounce weight should balance hundreds of pounds, by the intervention of a few bars of thin iron? Can anything surprise us more, than to find that the colour of white is a mixture of all others; that red, and blue, and green, and all the rest, merely by being blended in certain proportions, form what we had fancied rather to be no colour at all than *all colours together?* That the diamond should be made of the same material with coal; that water should be chiefly composed of an inflammable substance; that acids should be almost all formed of different kinds of air; and that one of those acids, whose strength can dissolve almost any of the metals, should be made of the self-same ingredients with the common air we breathe:—these, surely, are things to excite the wonder of any reflecting mind, nay, of any one but little accustomed to reflect. And yet these are trifling when compared to the prodigies which astronomy opens to our view: the enormous masses of the heavenly bodies; their immense distances; their countless numbers, and their motions, whose swiftness mocks the uttermost efforts of the imagination.

Akin to this pleasure of contemplating new and extraordinary truths, is the gratification of tracing resemblances and relations between things which, to common apprehension, seem widely different. It is surely a satisfaction, for instance, to know that the same thing which causes the sensation of heat causes also fluidity; that electricity, the light which is seen on the back of a cat when slightly rubbed on a frosty evening, is the same with the lightning of the clouds; that plants breathe like ourselves, but differently, by day and by night; that the air which burns in our lamps enables a balloon to mount. Nothing can at first sight appear less like, or less likely to be caused by the same thing, than the processes of burning and breathing,—the rusting of metals and burning,—the influence of a plant on the air it grows in by night, and of an animal on the same air at any time, nay, and of a body burning in that air;—and yet all these operations, so unlike to common eyes, are the same. Nothing can be less like than the working of a vast steam-engine and the crawling of a fly upon the window; yet we find that these two operations are performed by the same means—the weight of the atmosphere. Is there, in all the fairy tales that ever were fancied, anything more calculated to arrest the attention, and gratify the mind, than this most unexpected resemblance between things so unlike to the eyes of ordinary beholders? Then, if we raise our views to *the structure of the heavens*, we are again gratified with most unexpected resemblances. Is it not in the highest degree interesting to find, that the power which keeps the earth in its path, wheeling round the sun, extends over all the other worlds that compose the universe, and gives to each its proper place and motion; that the same power keeps the moon in her path round the earth; that the same power causes the tides upon our earth, and the peculiar form of the earth itself; and that, after all, it is the same power which makes a stone fall to the ground?

The highest of all our gratifications in the study of science remains. We are raised by science to an understanding of the infinite wisdom and goodness which the Creator has displayed in all his works. Not a step can we take in any direction without perceiving the most extraordinary traces of design; and the skill everywhere conspicuous is calculated in so vast a proportion of instances to promote the happiness of living creatures, and especially of ourselves, that we can feel no hesitation in concluding, that if we knew the whole scheme of Providence, every part would appear to be in harmony with a plan of absolute benevolence. Independently, however, of this most consoling inference, the delight is inexpressible of being able to follow, as it were, with our eyes, the marvellous works of the great Architect of Nature, and to trace the unbounded power and exquisite skill which are exhibited in the most minute as well as in the mightiest parts of his system.

BROUGHAM.

GOD IN NATURE.

THERE lives and works
A soul in all things, and that soul is God.
The beauties of the wilderness are His,
That makes so gay the solitary place,
Where no eye sees them. And the fairer forms
That cultivation glories in, are His.
He sets the bright procession on its way,
And marshals all the order of the year;
He marks the bounds which Winter may not pass,
And blunts his pointed fury; in its case,
Russet and rude, folds up the tender germ,

Uninjured, with inimitable art;
And, ere one flowery season fades and dies,
Designs the blooming wonders of the next.
The Lord of all, Himself through all diffused,
Sustains, and is the life of all that lives.
Nature is but a name for an effect,
Whose cause is God. One spirit—His,
Who wore the platted thorns with bleeding brows—
Rules universal nature. Not a flower
But shows some touch, in freckle, streak, or stain,
Of His unrivalled pencil. He inspires
Their balmy odours, and imparts their hues,
And bathes their eyes with nectar, and includes,
In grains as countless as the seaside sands,
The forms with which He sprinkles all the earth.
Happy who walks with Him! whom what he finds
Of flavour or of scent in fruit or flower,
Or what he views of beautiful or grand
In Nature, from the broad majestic oak
To the green blade that twinkles in the sun,
Prompts with remembrance of a present God. COWPER.

THOU art, O God! the life and light
Of all this wondrous world we see;
Its glow by day, its smile by night,
Are but reflections caught from Thee:
Where'er we turn, Thy glories shine,
And all things fair and bright are Thine!

When Day, with farewell beam, delays
Among the opening clouds of Even,
And we can almost think we gaze
Through golden vistas into Heaven—
Those hues that mark the sun's decline,
So soft, so radiant, Lord! are Thine.

When Night, with wings of starry gloom,
O'ershadows all the earth and skies,
Like some dark beauteous bird, whose plume
Is sparkling with a thousand eyes—
That sacred gloom, those fires divine,
So grand, so countless, Lord! are Thine.

When youthful Spring around us breathes,
Thy spirit warms her fragrant sigh,

And every flower the Summer wreathes,
  Is born beneath that kindling eye:
Where'er we turn, Thy glories shine,
And all things bright and fair are Thine! MOORE.

DIGNITY AND ACHIEVEMENTS OF LABOUR.

IT is time that the opprobrium of toil were done away. Ashamed of toil, art thou? Ashamed of thy dingy workshop or dusty labour-field; of thy hard hand, scarred with service more honourable than that of war; of thy soiled and weather-stained garments, on which mother Nature has embroidered, midst sun and rain, midst smoke and steam, her own heraldic honours? Ashamed of these tokens and titles, and envious of the flaunting robes of imbecile idleness and vanity? It is treason to Nature, it is impiety to Heaven. Toil—toil, either of the brain, of the heart, or of the hand—is true nobility. DEWEY.

THE productive classes of the world include those who bless it by their thought as well as those who bless it by their work. He who invents a machine does no less a service than he who toils all day with his hands. Thus the inventors of the plough, the loom, and the ship, have been deservedly placed among those whom society ought to honour. But they also, who teach men moral and religious truth—who instruct them to think, to live together in peace, to love one another, and pass good lives—are benefactors of the world, nay, its greatest benefactors. They speak to the deepest wants of the soul, and give men the true bread from heaven. PARKER.

LABOUR clears the forest and drains the morass. Labour drives the plough, scatters the seed, reaps the harvest, grinds the corn, and converts it into bread, the staff of life. Labour gathers the cotton from the field, and the fleece from the flock, and weaves it into raiment. Labour moulds the brick, splits the slate, quarries the stone, shapes the column, and rears not only the humble cottage, but the sumptuous palace. Labour, diving deep into the earth, brings up the long-hidden metals, coins the gold and silver into money, and moulds the iron into a thousand shapes for use and ornament. Labour hews down the gnarled oak, and shapes the timber, and builds the ship, and guides it over the deep. Labour, laughing at difficulties, spans majestic rivers, carries viaducts over marshy swamps, suspends aerial bridges over deep ravines, tunnels the solid mountain, and links together, with its iron but loving grasp, all nations of the earth. Labour draws forth its delicate iron-thread, and stretching it from city to city, and from province to province, constructs a chariot on which speech may outstrip the wind, and compete with the lightning. Labour seizes the thoughts of genius, the discoveries of science, the admonitions of piety, and, with its types impressing the vacant page, perpetuates truth to distant ages, and diffuses it to all mankind. Wherever Labour waves its magic wand, Science arises to explore the universe; Art puts on its beautiful garments; Literature lifts up its voice in oration and song; Humanity rejoices; Piety exults. NEWMAN HALL.

LET me consider what I owe to the advanced industry of the present age. I am lodged in a house that affords me conveniences and comforts which even a king could not command some centuries ago. There are ships crossing the seas in every direction, to bring what is useful to me from all parts of the earth. In China, men are gathering the tea-leaf for me; in America, they are planting cotton for me; in the West India islands, they are preparing my sugar and my coffee; in Italy, they are feeding silk-worms for me; in Saxony, they are shearing the sheep to make me clothing; at home, powerful steam-engines are spinning and weaving for me, and making cutlery for me, and pumping the mines that minerals useful to me may be procured. My patrimony was small, yet I have carriages running day and night to carry my correspondence; I have roads, and canals, and bridges, to bear the coal for my winter fire; nay, I have protecting fleets and armies around my happy country, to secure my enjoyments and repose. Then

I have editors and printers, who daily send me an account of what is going on throughout the world, among all these people who serve me; and in a corner of my house I have *books*, the miracle of all my possessions, more wonderful than the wishing-cap of the Arabian tales; for they transport me instantly, not only to all places, but to all times.

ARNOTT.

LABOUR is life:—'tis the still water faileth;
Idleness ever despaireth, bewaileth;
  Flowers droop and die in the stillness of noon.
Labour is glory:—the *flying* cloud lightens;
Only the *waving* wing changes and brightens:—
  Play the sweet keys wouldst thou keep them in tune.
Work, and pure slumbers shall wait on thy pillow;
Lie not down wearied 'neath woe's weeping willow,—
  Work with a stout heart and resolute will.
Work at thy task, be it ever so lowly,—
Work, for all labour is noble and holy:
  Sloth is the parent of nothing but ill!

LONGFELLOW.

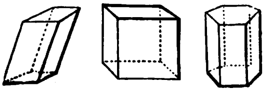
THE THREE KINGDOMS OF NATURE.

NATURAL objects may be conveniently classed under the three grand divisions of *Minerals*, *Vegetables*, and *Animals*. This classification, indeed, is open to the objection of not being wholly exhaustive, inasmuch as there are some things, such as water and air, which are not comprehended under it. Yet it is sufficiently accurate for the purposes of popular science; and if we agree to call water a mineral, it is also tolerably complete.

I. MINERALS.—Under the head of *minerals* are included all *inorganic* bodies—that is, all bodies destitute of organization and life, such as sand, clay, metals, etc. Minerals are usually found in a solid state, but not always. Thus, quicksilver is fluid, except when exposed to intense cold; lead does not cease to be a mineral when it is melted; and *water, if a mineral*, is entitled to the name, alike when it exists in its ordinary liquid form, when it is frozen into ice, and when it passes into the gaseous form of vapour or steam.

With the exception of the pure metals—gold, silver, copper, etc.—very few of the minerals are simple, uncompounded substances. Most of them are bodies made up of several ingredients; and while in some these ingredients are always the same and combined in the same proportion, in others they vary both in kind and in degree. Thus, limestone is always made up of lime and carbonic acid combined in fixed proportions; whereas sandstone is composed of grains of all sorts of substances mingled together without any regard to quality or proportion.

The minerals which are composed of definite ingredients are distinguished by a very remarkable property. On passing from a fluid to a solid state, they always assume the form of what is called *crystals;* a word which is used in science to denote, not transparency, but regularity of shape. A few, indeed, become transparent; as, for instance, a piece of limestone, which loses its dull appearance and becomes clear like glass. But most of them retain their opacity, and acquire only a crystalline form. Nor is it only after a process of artificial fusion that minerals thus crystallize; many of them occur in their natural state as crystals. Crystals of carbonate of lime, for example, are found in great abundance in the veins of many limestone rocks; and some limestones consist almost entirely of an assemblage of interlaced crystals.



The whole crust of the earth is composed of minerals, which generally lie one above another in beds or *strata* of various thickness. These beds are in some places nearly horizontal; but in other instances, particularly in mountainous countries, they have a waving or bending form, their different degrees of inclination determining the external shape or contour of a district.

II. VEGETABLES.—Vegetables or Plants are not mere in*organic substances* like minerals, but possess the higher properties of organization and life. They are all, from the majestic tree to the microscopic fungus, living, organized bodies.

Apart from other characteristics, there is enough to distinguish plants from minerals, in the mere fact that they *grow.* A mineral does not and cannot grow. If it increases in bulk, as in the case of a rolling snowball, or an accumulating heap of gravel, the increase is due, not to any action or movement from within, but to additions or accretions from without. A plant, on the other hand, increases in size by expansion from within—by self-development—by growth. A block of sandstone is only a collection of sand-grains heaped one upon another; an oak tree is an acorn developed by growth.

A plant has two sets of organs; *nutritive* organs, as the root, the stem, the leaves, which collect and prepare the food that builds up the plant; and *reproductive* organs, as the flower, wherewith to produce and mature the seed. A few plants which have no flowers produce seeds, or rather germs, by means of other and peculiar organs. But all the more familiar plants bear flowers which produce the seed. The flowerless plants are chiefly the ferns, mosses, lichens, seaweeds, and mushrooms.

The most important function performed by plants is that of preparing food for man and the other members of the animal kingdom. For this end they feed on mineral substances, and, by a wonderful process of assimilation, convert these into vegetable substances. Man and the lower animals cannot feed on inorganic matter. No mineral, with the single exception of salt, is fit food for animals. But mineral substances are the appropriate food of plants; and it is by taking up these substances into their own structure, and converting them into starch, sugar, and other vegetable products, that plants prepare suitable nutriment for the animal creation.

Besides preparing food for animals, plants perform the almost equally important function of purifying the air. As animals in breathing constantly inhale oxygen and exhale foul air, the effect of animal respiration is necessarily to deteriorate the atmosphere by withdrawing the oxygen and replacing it by noxious gases; and were this process to be allowed to go on without check or counteraction, the atmosphere would erelong become as fatal to animal life as the Black Hole of Calcutta. Such a disastrous result is precluded by the agency of plants. They possess the property of absorbing the noxious gases and of giving out oxygen. They, therefore, withdraw from the atmosphere what animals impart to it, and supply to it what animals consume. And thus the gases which compose the air we breathe are constantly maintained in the proportion necessary to the support of life.

Plants are the more serviceable to man, that they admit of being modified and improved by culture. By means of buds or slips, or a change of soil and climate, we may produce what is called a *variety*, that is, an individual plant differing in some respects from the species to which it belongs; and in proof of the immense value to us of this property of plants, it will suffice to name the fact that our cereal crops, culinary vegetables, and orchard fruits are all *varieties*. These varieties, it is true, cannot be considered as a permanent addition to the vegetable kingdom, for when their seeds are sown in ordinary soil and left to grow wild, they rapidly degenerate and erelong return to the type of the original species. Yet, when carefully cultivated—as by the farmer in the case of the grains, and by the horticulturist in the case of the fruits—they may be continued for generations; and when old varieties fail, new ones, of equal value to man, may be produced and propagated.

The number of individual plants is beyond all computation. Even the known species are upwards of 120,000; while there are, doubtless, many thousands more yet destined to reward the search of the botanist. They are universally diffused,—most abundant, indeed, in tropical regions, and more sparse as we approach towards the poles, but nowhere absent. And, what specially argues the goodness of the Great Maker, they are invariably distributed in fine adaptation to the exigencies alike of climate and of animal life; *every zone, nay, every* district of every zone, yielding the tree, the shrub, the herbaceous plant, best adapted to its atmospheric and animal necessities.

III. ANIMALS.—Besides organization and life, *Animals* possess voluntary motion and sensation. Plants are stationary; animals have the power of free movement. Plants have no sense of their own beauty or fragrance; animals have the capacity of perceiving and feeling. And in the case of man, the head of the animal kingdom, there are the yet higher powers of reason and conscience.

Animal life being of a higher order than vegetable life, it is natural to expect a more complicated organization in animals than in plants. Nor is this greater elaborateness of structure apparent only in those organs which are peculiar to animals — the organs of motion and sensation; it is equally apparent in the nutritive and reproductive organs. In proof of this, we need only look at the organs by which animals procure their food. These organs are of every form of construction, comprising prehensile machines, pumps, syphons, saws, projectiles. The talons of the eagle, the claws of the tiger, the proboscis of the elephant, are examples of organs of prehension. The double tube of the butterfly which takes up liquid nutriment, and the lancet of the gnat which at once pierces the skin of its prey and forms a tube for suction, are examples of pumps and suckers. Even in the creatures of low organization which inhabit the sea, the organs for procuring food display an exquisite mechanism. Many of the humble molluscs are furnished with a tongue that can rasp the sea-weed so as to reduce it to a pulp. The starfish has hundreds of tubular suckers with which to seize any unfortunate periwinkle that may come in its way. The sea-jellies have long contractile filaments by which to sting and grasp their victims. And one little fish (*Choetodon rostratus*) has a projectile apparatus which enables it to shoot with a drop of water the small flies on which it lives.

That, however, which chiefly raises animals above plants in the scale of being, is the system of organs which we call the Nerves and Brain. For with the nervous system are connected in some mysterious way which we cannot explain, not only the powers of locomotion and sensation, but also those admirable faculties which constitute the instincts of animals, and, in the case of man, culminate in reason and conscience. How numerous and marvellous are the instincts of the lower animals! They have instincts for self-sustenance; instincts for self-defence; instincts for the production and support of their offspring; instincts of migration, of nest-building, of incubation, of gregariousness: and some of them, as the domestic dog and horse, exhibit acquired as well as original instincts, which in a generation or two become hereditary.

Immense as is the number of plants, the number of animals is far greater. Every spot of earth, every tree, every leaf, every bunch of seaweed, every drop of water, is peopled with living inhabitants. "Everywhere," says Humboldt, "even near the icebound poles, the air resounds with the song of birds, and with the busy hum of insects." In fact, creation, throughout all its departments, swarms with living beings; and while some of the countless myriads are so large that man is but a pigmy in comparison, others are so diminutive that even the microscope fails to reveal them to our senses.

These Three Kingdoms of Nature are closely connected and mutually dependent. The inorganic kingdom supports the vegetable, and the vegetable kingdom is essential to the existence and development of the animal. The animal kingdom, again, exhibits within itself a chain of dependence and development in the gradual modification of the nervous system from the zoophyte up to man. "Thus," as Dr Struthers finely remarks, "the whole scheme of nature may be likened to a pyramid in three successive zones towering upwards to a summit, on the top of which is placed a human brain, the habitation of mind—there fitly placed as the connecting link between the material and mortal below, and the spiritual and immortal above." *Compiled.*

THE VISION OF MIRZA.

On the fifth day of the moon, which I always keep holy, *after having washed myself* and offered up my morning devotions, I ascended the high hills of Bagdad, in order to pass the rest of the day in meditation and prayer. As I was airing myself on the tops of the mountains, I fell into a profound contemplation on the vanity of human life; and passing from one thought to another, "Surely," said I, "man is but a shadow, and life a dream." Whilst I was thus musing, the Genius who haunts the mountain came to me, and taking me by the hand, said, with a look of compassion and affability, "Mirza, I have heard thee in thy soliloquies; follow me."

He then led me to the highest pinnacle, and placing me on the top of it, "Cast thy eyes eastward," said he, "and tell me what thou seest."—"I see," said I, "a huge valley and a prodigious tide of water rolling through it."—"The valley that thou seest," said he, "is the Vale of Misery, and the tide of water that thou seest is part of the great Tide of Eternity."—"What is the reason," said I, "that the tide I see rises out of a thick mist at one end, and again loses itself in a thick mist at the other?"—"What thou seest," said he, "is that portion of Eternity which is called Time, measured out by the sun, and reaching from the beginning of the world to its consummation. Examine now this sea, and tell me what thou discoverest in it."—"I see a bridge," said I, "standing in the midst of the tide."—"The bridge thou seest," said he, "is human Life; consider it attentively." Upon a more leisurely survey of it, I found that it consisted of threescore and ten entire arches, with several broken arches, which, added to those that were entire, made up the number about an hundred. As I was counting the arches, the Genius told me that this bridge consisted at first of a thousand arches, but that a great flood swept away the rest, and left the bridge in the ruinous condition I now beheld it. "But tell me further," said he, "what thou discoverest on it."—"I see multitudes of people passing over it," said I, "and a black cloud hanging on each end of it." As I looked more attentively, I saw several of the passengers dropping through the bridge, into the great tide that flowed underneath it; and *upon further examination*, perceived there were innumerable trap-doors that lay concealed in the bridge, which the passengers no sooner trod upon but they fell through them into the tide and immediately disappeared. These hidden pitfalls were set very thick at the entrance of the bridge, so that throngs of people no sooner broke through the cloud but many fell into them. They grew thinner towards the middle, but multiplied and lay closer together towards the end of the arches that were entire. There were indeed some persons, but their number was very small, that continued a kind of hobbling march on the broken arches, but fell through one after another, being quite tired and spent with so long a walk.

I passed some time in the contemplation of this wonderful structure, and the variety of objects which it presented; and as I looked, my heart was filled with a deep melancholy. "Alas!" said I, "man was made in vain! How is he given away to misery and mortality!" The Genius, being moved with compassion towards me, bid me quit so uncomfortable a prospect. "Look no more," said he, "on man in the first stage of his existence, in his setting out for eternity; but cast thine eye on that thick mist into which the tide bears the several generations of mortals that fall into it." I directed my sight as I was ordered, and (whether or no the good Genius strengthened it with any supernatural force, or dissipated part of the mist that was before too thick for the eye to penetrate) I saw the valley opening at the further end, and spreading forth into an immense ocean, that had a huge rock of adamant running through the midst of it, and dividing it into two equal parts. The clouds still rested on one half of it, insomuch that I could discover nothing in it; but the other appeared to me a vast ocean planted with innumerable islands, that were covered with fruits and flowers, and interwoven with a thousand little shining seas that ran among them. I could see persons dressed in glorious habits, with garlands upon their heads, passing among the trees, lying down by the sides of fountains, or resting on beds of flowers; and could hear a confused harmony of singing birds, falling waters, human voices, and musical instruments. *Gladness grew in me upon* the discovery of so delightful a scene. I wished for the wings of an eagle that I might fly away to those happy seats. But the Genius told me that there was no passage to them, except through the gates of death that I saw opening every moment upon the bridge. "The islands," said he, "that lie so fresh and green before thee, are the mansions of good men after death, who, according to the degree and kinds of virtue in which they excelled, are distributed among these several islands, which abound with pleasures suitable to the relishes and perfections of those who are settled in them; every island is a paradise accommodated to its respective inhabitants. Are not these, O Mirza, habitations worth contending for? Does Life appear miserable, that gives thee opportunities of earning such a reward? Is Death to be feared, that will convey thee to so happy an existence? Think not man was made in vain, who has such an eternity reserved for him."

I gazed with inexpressible pleasure on these happy islands. At length, said I, "Show me now, I beseech thee, the secrets that lie hid under those dark clouds which cover the ocean on the other side of the rock of adamant." The Genius making me no answer, I turned about to address myself to him a second time, but I found that he had left me. I then turned again to the vision which I had been so long contemplating, but instead of the rolling tide, the arched bridge, and the happy islands, I saw nothing but the long hollow valley of Bagdad, with oxen, sheep, and camels grazing upon the sides of it. ADDISON.

THE BURIAL OF SIR JOHN MOORE.

NOT a drum was heard, not a funeral note,
As his corse to the rampart we hurried;
Not a soldier discharged his farewell shot
O'er the grave where our hero we buried.

We buried him darkly at dead of night,
The sods with our bayonets turning,
By the struggling moonbeam's misty light,
And the lantern dimly burning.

No useless coffin enclosed his breast,
  Not in sheet or in shroud we wound him;
But he lay like a warrior taking his rest,
  With his martial cloak around him.

Few and short were the prayers we said,
  And we spoke not a word of sorrow;
But we steadfastly gazed on the face that was dead,
  And we bitterly thought of the morrow.

We thought as we hollowed his narrow bed,
  And smoothed down his lonely pillow,
That the foe and the stranger would tread o'er his head,
  And we far away on the billow!

Lightly they'll talk of the spirit that's gone,
  And o'er his cold ashes upbraid him,—
But little he'll reck, if they let him sleep on
  In the grave where a Briton has laid him.

But half of our heavy task was done,
  When the clock struck the hour for retiring;
And we heard the distant and random gun
  That the foe was sullenly firing.

Slowly and sadly we laid him down,
  From the field of his fame fresh and gory;
We carved not a line, and we raised not a stone—
  But we left him alone with his glory.

WOLFE.

LANGUAGE.

LANGUAGE is the outward medium or vehicle by which men communicate their thoughts one to another. It exists, among all nations, in the form of Spoken Language or Speech; and among civilized nations, in the further form of Written or Printed Language. Spoken Language consists of breath-sounds formed by the human voice, and addressed to the sense of hearing; Written Language, of visible signs of these breath-sounds, addressed to the sense of sight.

The human voice owes its power to a complicated assemblage of organs which act upon the air, and modulate it, as it passes through them, into various sounds. The chief of these organs are, the lungs, or air-vessels in the cavity of the chest,—the windpipe, or tube by which the air passes to and from the lungs,—the glottis, or narrow slit at the top of the windpipe,—the throat,—the palate,—the nostrils,—the teeth,—the lips,—and the tongue. The air, in passing and repassing through the windpipe, is formed into vibrations or tones by the action of the glottis,* which opens and shuts for the purpose; and these tones are again modified into articulate sounds by the interposition and motions of the throat, the teeth, the nostrils, and the lips, but especially the tongue.

The power of the human voice may be in part explained by a reference to musical instruments, particularly the organ. The lungs are the bellows; the throat and nostrils, the pipes; the cavity of the mouth, the windchest; and the interior divisions of the mouth, the stops. Strictly speaking, however, the human voice can be fully represented by no single musical instrument. It unites the advantages of the flute, the violin, and the organ, or, in other words, of wind, stringed, and keyed instruments combined.

The sounds produced by the organs of speech are of two kinds—vocal and articulate. Vocal or vowel sounds are produced by causing streams of breath to pass through the throat and mouth when the organs are open; and they are always pure uncompounded sounds. Articulate or jointed sounds are produced by the closing of one or more of the organs while the breath-streams are passing through; and they are each resolvable into a tone or vocal sound and a pulsation or stop. The melodiousness of a language depends, in a good measure, upon the proportion of the vocal to the jointed sounds,—a language becoming harsh if the latter greatly preponderate.

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* "The glottis, or narrow opening at the top of the windpipe, is situated just behind the root of the tongue. It is that which is felt to close suddenly in hiccough, arresting the ingress of air; and that which closes to prevent the egress of air from the chest of a person lifting a heavy weight, or making any straining exertion; it is also that by the repeated shutting of which a person divides the sound in pronouncing several times in rapid succession any vowel, as o, o, o, o."—*Arnott on Physics.*

Spoken language must have had an existence coeval with man, or at least with human society in its earliest condition. Written language is of later date. Its invention was probably reserved till men, multiplied into tribes and nations, required to communicate their thoughts secretly, and to a distance. So long as strict secrecy was needless, they might communicate even with distant correspondents by means of oral messages; but whenever the interests of society became sufficiently complicated to render secrecy desirable or misrepresentation dangerous, recourse would doubtless be had to conventional signs for the purpose of conducting correspondence. Thus, in all probability, Written language was originally resorted to for the same end as the cipher-writing of the present day.

The signs which Written language employs for perception through the sight are of course intended to represent the sounds which Spoken language addresses to the hearing. But they do not strictly represent these sounds. There is no point of contact between the sense of sight and that of hearing. All that can be said is, that, by tacit convention, certain visible signs are made to awaken in the mind the idea of certain audible sounds; which sounds, by another tacit agreement, suggest the ideas which language is designed to communicate.

In all but a very few languages, only as many visible signs are employed as are needed to represent the elementary or ultimate sounds into which Speech is resolvable. These signs, which seldom exceed twenty-six in number, are called alphabetic characters or letters; and—like the two classes of sounds, vocal and jointed, which they represent—they are divided into vowels and consonants. But in none of our existing alphabets do the letters exactly correspond in number with the elementary sounds of the language; the reason of which is, that our present alphabets, instead of having been framed in express adaptation to their respective languages, have all been derived from previously existing alphabets. The alphabet most generally used in Modern Europe is but a new edition of the Roman alphabet. The Roman alphabet, again, was derived from the Greek. That, in its turn, was received from the Phœnicians. And the Phœnician alphabet is conjectured to have been borrowed from that previously existing among the Jews, of which the origin is unknown.

The Alphabetic, though the simplest and most perfect of all modes of writing, was probably the last invented. But by whom, and at what period it was invented, we have no means of determining. Nor is it even certainly known what those earlier forms of written language were, which preceded it, and perhaps suggested it. This much, however, is clear, that the idea of resolving language into its ultimate sounds, and betokening these by conventional signs, is one of the happiest and most valuable that was ever suggested to the human mind.

Besides Speech and Writing, there is another mode of communicating facts and ideas, which, though it cannot be rightly called language, is often a good substitute for language—namely, Signals and Tokens for the ear and the eye. Of such Signals are the ringing of bells to call people to worship; the clapping of hands in approbation of a skilful performance; the whistle of the railway engine, to give warning of the coming of the train; the hoisting of flags of different forms and colours, to convey an admiral's orders to his fleet, such as was Nelson's signal, "England expects every man to do his duty." As examples of Tokens, it may suffice to name the uniform and badges of soldiers, which show to what regiment they belong, and the rank they hold in it; the gowns and hoods worn by members of the universities, which announce the office they fill, and the degrees they have taken; the wedding-ring, which betokens a woman's wifehood; and her mourning weeds, which show her widowhood.

Compiled.

BOOKS, AND HOW TO READ THEM.

It is hardly possible to overrate the influence which the Pen and the Press confer upon the instructors of mankind. Spoken words reach only a few ears; and their effect is seldom more permanent than the figures sketched on the sand, which the next tide obliterates for ever. But the press gives both diffusion and perpetuity to speech. It causes words which were originally addressed to hundreds, to be heard by millions; and enables a gifted teacher to speak even after he has gone to his grave—nay, to speak to the ends of the earth, and to the end of time.

Nor is the power less wonderful which Books convey to their readers. The elder Cato comforted himself in the prospect of death, by anticipating his admission to the society of departed sages. But with the writings of the ancient worthies in our hands, we require not to die, in order to converse with "that divine assembly of exalted spirits." In the little body of thought which lies before us in the shape of a book, we possess the constant companionship of its author. In a single apartment, walled with shelves, we have around us the assembled spirits of the wise and good of all time, waiting to enrich us with their knowledge and experience. The orators declaim for us; the historians recite; the poets sing. Nay, books invest us with a sort of omnipresence. With the warrior, we live over again the struggles of the battle. With the traveller, we cross again the ocean, and climb the Alps, and tread with glowing heart the classic soil. With the philosopher, we adjust anew the lamp and the crucible, and watch with breathless interest for the spark or the effervescence which is to confirm or overthrow the favourite theory. By our books we can be in all places and live throughout all past time.

No language is richer in good books than our own. Scarcely can any subject of human thought be named, which has not engaged the pen of some one or other of our great authors. In what other literary firmament shall we find such a constellation of poets as Chaucer, Shakspeare, *Milton, Dryden, Pope,* Cowper, Gray, Burns, Wordsworth, Byron? What other nation can boast of better historians than Clarendon, Hume, Robertson, Gibbon, Hallam, Macaulay; or of sager philosophers than Bacon, Newton, Locke, Reid, Hamilton; or of truer orators than Chatham, Burke, Hall, Chalmers; or of better novelists than Defoe, Richardson, Fielding, Scott; or of more pleasing essayists than Addison, Goldsmith, and Washington Irving? For the last three hundred years many of the most gifted minds in England have been devoted to the pursuit of letters; and the result of their conjoint labours, is a Body of Literature unrivalled in extent and in value.

No single person can be expected to read all the books in our language. Nor, even were such a thing practicable, would it be advisable. The improvement of the mind is more effectually promoted by the careful study of a few well-selected books than by the hasty perusal of a whole library,—even as the body is better warmed by exercise than by weight of clothing. Besides, there are many books so positively bad, that the effect of perusing them would be to demoralize and degrade us; while there are also not a few which, though rich in valuable thoughts, yet present them so intermixed with pestilent matter, that the benefit they offer would be dearly purchased at the cost of the mischief they might simultaneously inflict. Better go without the pearls which lie at the bottom of a deep and rapid river, than encounter the risk of diving for them.

If we would profit by our reading, we must be careful not only to select proper books, but also to peruse them aright. The same book will affect its readers differently according to the purpose with which they read it. The butterfly flits over the flower-bed, and gathers nothing; the spider collects poison from it; but the bee finds and stores up honey; and so the object for which you go to a book will determine the kind of fruit it will yield you. The same volume may be made to minister to instruction, or to rational amusement, or to a mere morbid love of excitement. The child takes off the lid of the tea-kettle for sport; the housewife for use;—but James Watt for science, which ended in the improvement of the steam-engine.

Reading furnishes us only with the materials of knowledge; it is *thinking* that makes what we read our own. We must attend to what we read, if we would understand it; we must go over it again and again, if we would remember it; and if we would digest it so that it may nourish and invigorate our minds, we must exercise ourselves upon it by frequent and earnest reflection. In reading descriptive works, such as voyages and travels, we should try to reproduce in our own minds the scenes described, and call in the aid of maps and drawings to assist our conceptions. In reading history, biography, and other narrative works, we should endeavour, after closing the book, to restate mentally to ourselves, or orally to a friend. the substance of the narrative. In the case of books of a philosophic or argumentative character, we should often pause in the course of reading, to ask ourselves what is the drift of the writer, and to estimate the soundness and force of his reasoning. The practice of reproducing the substance of what we read in our own words is quite invaluable as a help to profitable reading; for we thereby not only improve our power of expression, but ensure a clearer comprehension of the subject. No one can clearly state even to himself what he does not understand; and the attempt, therefore, to report the contents of a book either to ourselves or to a friend, cannot but call into salutary exercise our powers of intelligence and conception. To repeat the substance of our reading to another is better than repeating it to ourselves, because we are more excited to accuracy both of thought and of expression. And it is a yet better practice to put in writing our recollections and impressions of a book; for in the process of written composition we must arrange and methodize our thoughts before we can express them in a proper form.

Few things are better worth cultivating than a taste for reading. "If," says Sir John Herschel, "I were to pray for a taste which, next to the consolations of religion, would stand me in stead under every variety of circumstances, it would be a taste for reading." That great statesman Pitt had the same conviction; for he often escaped from the roar of political contention into the solemn retirements of a favourite author. One visiter found him reading Milton aloud with strong emphasis, and so deeply engaged in Paradise as to have forgotten the presence of any people in the world except Adam and Eve. Compare with this happy portrait the confession of Sir Robert Walpole to Mr Fox in the library at Houghton,—"I wish I took as much delight in reading as you do: it would be the means of alleviating many tedious hours in my present retirement; but, to my misfortune, I derive no pleasure from such pursuits."

Compiled.

THE NIGHTINGALE.

Sweet bird, that shunn'st the noise of folly,
Most musical, most melancholy!
Thee, chantress, oft, the woods among,
I woo, to hear thy even-song!
And, missing thee, I walk unseen
On the dry smooth-shaven green,
To behold the wandering moon,
Riding near her highest noon,
Like one that had been led astray
Through the heaven's wide pathless way. MILTON.

Come, we will rest on this old mossy bridge!
You see the glimmer of the stream beneath,
But hear no murmuring: it flows silently
O'er its soft bed of verdure. All is still.
A balmy night! and though the stars be dim,
Yet let us think upon the vernal showers
That gladden the green earth, and we shall find
A pleasure in the dimness of the stars.
And, hark! the Nightingale begins its song,
"Most musical, most melancholy" bird!
A melancholy bird? Oh, idle thought!
In nature there is nothing melancholy.
But some night-wandering man, whose heart was pierced
With the remembrance of a grievous wrong,
Or slow distemper, or neglected love
(And so, poor wretch! filled all things with himself,

And made all gentle sounds tell back the tale
Of his own sorrow), he, and such as he,
First named these notes a melancholy strain.
And many a poet echoes the conceit;
Poet who hath been building up the rhyme
When he had better far have stretched his limbs
Beside a brook in mossy forest-dell,
By sun or moonlight, to the influxes
Of shapes and sounds and shifting elements
Surrendering his whole spirit! so his song
Should make all Nature lovelier, and itself
Be loved like Nature! But 'twill not be so;
And youths and maidens most poetical,
Who lose the deepening twilights of the spring
In ball-rooms and hot theatres, they still,
Full of meek sympathy, must heave their sighs
O'er Philomela's pity-pleading strains.
  My Friend, and thou, our Sister! we have learnt
A different lore: we may not thus profane
Nature's sweet voices, always full of love
And joyance! 'Tis the merry Nightingale
That crowds, and hurries, and precipitates,
With fast thick warble, his delicious notes,
As he were fearful that an April night
Would be too short for him to utter forth
His love-chant, and disburthen his full soul
Of all its music! COLERIDGE.

ROTUNDITY OF THE EARTH.

THE spherical form of the earth is the fundamental principle of geography. The proofs of this truth consist in certain remarkable appearances, either of objects upon the surface of the earth, or of the heavenly bodies.

Why do towers, vessels, and mountains, when we recede from them, appear to sink below the horizon, commencing with the base; and why, on the contrary, when we approach them, do these objects show first their summits, then their middle, and last of all their bases? These phenomena prove evidently that an apparent plane upon the earth is a curved surface, and that it is the convexity of this surface which conceals from the eye of the spectator upon the beach the hull of the vessel of which he sees the masts and sails. These things, too, happen uniformly towards whatever part of the earth we travel, whether towards the east or towards the west, towards the north or towards the south. It is impossible, therefore, to avoid drawing the conclusion, that the whole surface of the earth is, on all sides, nearly regularly curved; or, in other words, that the earth is a body approaching in figure more or less to a sphere.

The same inference is deducible from an observation of the heavens. The *polestar* is that point in the heavens, which, itself immovable, appears to serve as a pivot to the apparent motions of the heavenly bodies. Now, if we proceed towards the north, we see the polestar take a position more elevated in the heavens; but if we go towards the south, this same star appears to sink. It is, therefore, impossible that the line whose direction we follow can be a straight line traced upon a horizontal plane; it can only be a curve; and as the same change everywhere takes place, it is natural to conclude that the earth has at least a circular form from north to south. The fact that the sun rises sooner to those who dwell towards the east, and gradually later to others in proportion as they are further west, proves that the earth is equally circular from east to west; for were it flat, the sun would begin to illuminate all parts of its surface at the same instant.

Another proof is furnished by the eclipses of the moon. These eclipses are known to be caused by the earth coming between the sun and the moon, and cutting off the light which illuminates the moon's disk; the dark part of the moon's disk is, therefore, nothing more than a representation of the earth's shadow at the distance of the moon. Now, in whatever position the earth happens to be at the time of an eclipse, its shadow upon the moon's disk is always in the form of a circle or of part of a circle; the earth must, therefore, be a sphere.

The numerous voyages which have been made round the world lead to the same conclusion. Navigators, such as Magellan and Drake, sailing from Europe, have pursued a course *always towards the* west (making only some deviations, in order to double the lands which stretch towards the south), and, without quitting this general direction, have returned to the same place whence they set out. Heemskerk, when he wintered at Nova Zembla, confirmed what astronomers had concluded from the spherical figure of the earth; namely, that the days and nights near the poles extend to several months. Finally, Cook, in approaching as near as possible to the southern polar circle, found that the voyage round was always diminished proportionably to the diminution of his distance from the pole; so that we have thus obtained an ocular proof of the rotundity of the earth towards the south pole as well as towards the north.

So many united proofs leave no room for doubts as to the sphericity of our earth. In vain does ignorance demand how the earth can remain suspended in the air without any support. Let us look upon the heavens, and observe how many other globes roll in space. Let us lay aside all uneasiness concerning the *antipodes*, that is, the people on the opposite side of the globe; there is upon the globe neither high nor low; the antipodes see, as we do, the earth under their feet, and the sky over their heads.

MALTE-BRUN.

DIVINE TRUTH.

ALL truth is worth knowing—but, most of all, religious truth. Other kinds of truth, however important, have their value and use bounded by the present life; but religious truth is of eternal moment to us. Not to know *it*, is to be ignorant of God, of Christ, of the way of salvation, of all that belongs to our everlasting peace. And what other knowledge can compensate us for ignorance on such vital subjects?

But where is religious truth to be found? Nowhere except in the Gospel of Jesus Christ. Here all other teachers are but blind leaders of the blind. Christ's Holy Word is the only accredited guide to sure and certain knowledge.

In Christ's Word is revealed the truth *respecting God. Long before Christ* came, men had lost those just conceptions of God which they originally possessed. In most nations the doctrine of God's unity had wholly disappeared; and even where this was retained, His character was entirely misunderstood. Athens, the very seat of wisdom, had to confess the inability of all her sages to find out God, by dedicating an altar to "the unknown god." It was reserved for a disciple of Christ to stand on Mars' hill, and cry out to the Athenians, "Him whom ye ignorantly worship, declare I unto you!"

Not that even in the Gospel God is revealed in all the mysteries of His essence, perfections, and government. Such deep things are above the comprehension, and beyond the necessities of man. But everything that it really concerns us to know is revealed. That God is a Spirit; that He is everywhere present; that He condescends to be the object of our worship; that He exercises a ceaseless providence over us; that He bears towards each of us the love of a Father:—these sublime and consolatory truths were ever on the lips of Jesus, and were, moreover, set forth by him, not as conclusions deduced from elaborate reasonings, but as facts which he personally knew, and was divinely commissioned to reveal. Nor did Christ reveal God by his discourses only: he revealed Him also in his actions. Christ was God incarnate—God manifest in the flesh; and hence in his whole life on earth—his temper, his deportment, his works—we have a manifestation of God.

From Christ's Word we also learn the truth *respecting ourselves.* Strange as it may sound, there is no deeper enigma to man than man himself. But in the Gospel the riddle is explained. Here we learn that man was originally made in the image of God; that he is a creature composed of a body formed from the dust of the ground, and of a spirit breathed into him from heaven; that his liability to sickness and sorrow and death is due to his fall from his primeval uprightness; that guilty, there is yet hope of pardon for him; that prone to sin, there is yet hope of sanctification; and that his present condition of mingled joy and sorrow is only a discipline and preparation for a future and higher *state of existence.* Indeed, all the questions regarding man's origin, character, lot, and destiny, which so sorely perplexed the ancient sages, are resolved in the Gospel; and so consonant with reason and experience is the solution there given of them, that modern philosophy has been fain to borrow it, and palm it off as her own.

Nowhere, again, but in Christ's Word shall we find a true answer to the question, "*What must I do to be saved?*" The Jew takes it to his law; but the oracle of Zion is dumb. The Pagan takes it to his idol; but though he cry aloud to Baal from morning to evening, and cut himself with stones, and even offer the fruit of his body for the sin of his soul, he receives no response. The Deist takes it to Natural Religion, hoping to find in the volume of creation such a discovery of God as will quiet those fears which his heart has learnt from its guilt; but the oracle returns an equivocal answer; for if nature has its sunshine, its smiling landscapes, its plenteous harvests, to tell of the Creator's goodness, it has also its floods and tempests, its famines and pestilences, to proclaim His justice and vengeance. It is only at the foot of Christ's cross that we learn how sin can be forgiven, and the sinner saved. By the death of Christ in the room of sinners, divine justice has been satisfied; and on the ground of that great atonement, a just and holy God is now able to pardon and save all who renounce every other plea but that, and rest on that.

Nor is the Gospel less explicit on the subject of *our future destiny*. Heathen philosophy halted at the grave, unable to explore the land of shadows beyond, or so much as to conjecture the state of the departed. Nor was it given even to the Hebrew prophets to solve the momentous question, "If a man die, shall he live again?" But where all former wisdom had only made darkness visible, Christ shed resplendent light. He rolled away the stone from the sepulchre of human hope. By his own resurrection from the grave, as well as by his authoritative teaching, he made it certainly known, that death is but the birthtime of a higher life; that the soul does not lose its conscious existence when sundered from the body; and that "the hour is coming in the which *all that are in the graves* shall hear His voice, and shall come forth;—they that have done good, unto the resurrection of life; and they that have done evil, unto the resurrection of damnation." On yon early morning on the first day of the week when Christ left the tomb—having burst the bands of death, because it was impossible he should be holden of them—the dark riddle which had baffled all previous attempts to read it, was finally solved. And ever since, the followers of Christ have been privileged, not only to look upward to God as their reconciled Father, but to look onward beyond the grave, in the sure and certain hope of a glorious resurrection.

CHRISTOLOGY.

THAT glorious form, that light unsufferable,
And that far-beaming blaze of majesty,
Wherewith he wont at Heaven's high council-table
To sit the midst of Trinal Unity,
He laid aside; and, here with us to be,
Forsook the courts of everlasting day,
And chose with us a darksome house of mortal clay!

MILTON.

BOUND upon the accursed tree,
Faint and bleeding, who is He?
By the eyes so pale and dim,
Streaming blood and writhing limb,
By the flesh with scourges torn,
By the crown of twisted thorn,
By the side so deeply pierced,
By the baffled burning thirst,
By the drooping death-dewed brow,
Son of man! 'tis Thou, 'tis Thou!

Bound upon the accursed tree,
Dread and awful, who is He?
By the sun at noonday pale,
Shivering rocks, and rending veil,
By earth that trembles at His doom,
By yonder saints who burst their tomb,
By Eden, promised ere He died
To the felon at His side,

Lord! our suppliant knees we bow,
Son of God! 'tis Thou, 'tis Thou! **Milman.**

Oh! never, never canst thou know
What then for thee the Saviour bore,
The pangs of that mysterious woe
That wrung His frame at every pore,
The weight that pressed upon His brow,
The fever of His bosom's core!
Yes, man for man perchance may brave
The horrors of the yawning grave,
And friend for friend, or child for sire,
Undaunted and unmoved expire,—
From love—or piety—or pride;—
But who can die as Jesus died?

A sweet but solitary beam,
An emanation from above,
Glimmers o'er life's uncertain dream,
We hail that beam and call it love!
But fainter than the pale star's ray
Before the noontide blaze of day,
And lighter than the viewless sand
Beneath the wave that sweeps the strand,
Is all of love that man can know,—
All that in angel-breasts can glow,—
Compared, O Lord of Hosts! with Thine,
Eternal—fathomless—divine! **Dale.**

THE PHYSICAL FORCES.

The vegetable and animal kingdoms are in a state of perpetual change. No plant, no animal is to-day the same, either externally or internally, as it was yesterday; no living thing is ever at absolute rest. Nor is it otherwise in the inorganic kingdom. The earth, as a mass, is in perpetual motion, rotating on its axis and revolving round the sun; and the various substances of which it is composed are constantly undergoing mutation. Rocks are suffering disintegration, and rivers altering their beds. Here the *land gains upon the* sea, and there the sea encroaches on the land. The ocean is ceaselessly flowing or ebbing, and the atmosphere, with its variable winds and changeful clouds, is never entirely tranquil.

How are these changes to be explained? In the case of plants and animals, such changes are doubtless to be ascribed, at least in part, to that mysterious vital power with which they have been endowed; for life is notoriously an active and restless thing. But what of inorganic matter, which is essentially inert? how comes *it* to exhibit a similar changefulness?

Inquiry and observation show that all the changes in the inorganic world are due to certain *forces*, which act upon matter according to fixed laws. These physical forces are at least six in number, and usually go by the following names:— *Cohesion*, *Gravitation*, *Chemical Affinity*, *Heat*, *Electricity*, and *Magnetism*. Nor are they at all so hard to understand as such crabbed names might seem to indicate.

Cohesion.—If you take a piece of iron wire, and try to pull it in two, you will fail with all your strength to break or even lengthen it. But if you try the same thing with a piece of clay of the same thickness, you will easily succeed in severing it into two or more parts. Whence the difference? It is because the particles of iron composing the wire cohere more firmly together, and therefore offer greater resistance to your attempt to separate them than the particles of clay. In both cases the resisting force is the force of *cohesion*.

This force of cohesion is always in proportion to the closeness of the particles of which a body is composed. Each particle possesses the power of attracting, or drawing towards it, any other particle which is sufficiently near to be within the influence of its attraction, and the nearer the particles are, the greater is their mutual attraction. In a hard body like iron, where the particles are close and compact, the force of cohesion is greater than in a soft body like clay; and in a fluid like oil it is greater than in a thin fluid like water. In air, and other very rare fluids, the particles are so far apart that they exert little or no attraction. Indeed, this force has no *sensible* effect, unless the particles of a body are or appear to be in contact.

Not that particles of matter lose their attractive force when they cease through distance to exert it; they still retain it; and when again brought sufficiently near, they cohere as before. When you pound a piece of glass so as to reduce it to a fine powder, you seem to have completely destroyed the cohesion of the particles; for the slightest breath of wind will disperse them. But if you pile them together between two flat surfaces, and apply sufficient pressure to bring them close together, you will find that they become again a solid wall—the attraction of one particle to another forming, as it were, the cement which holds them together.

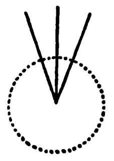
Not only does the cohesive force differ in different bodies according as their particles are closely or loosely compacted, but it often varies even in the same body, and acts more powerfully in one direction than in another. In other words, the same body may possess different powers of cohesion in different directions. Thus, a piece of wood splits with greater ease in the direction of the fibre than at right angles to it; a bit of mica splits into leaves; a piece of common salt splits into square or oblong fragments; a piece of Iceland spar splits into little rhomboids. Why is this but because in each of these bodies the attraction of the particles is weaker in one direction than in another? Each splits or breaks up at the points and in the direction where the attraction is weakest. In the case of wood the particles are held together by a strong force at right angles to the fibre, but by a feeble force in the direction of the fibre. In the case of crystalline minerals the cohesive force is feeblest in the line of what is called the *cleavage* of the crystals. If you try to divide a piece of Iceland spar with your knife in the direction of any of the surfaces of its crystals, you will be able to do so at once; but you cannot divide it across the crystals. By hammering you may break and bruise it into powder, but you cannot split it except into little rhomboids.

The valuable uses served by cohesion are too obvious to need enumeration. But for it, solid bodies would crumble into atoms. Iron and stone would lose their strength; timber would be unable to bear the slightest strain; we could have no buildings and no machinery; the whole globe would become a heap of shifting sand.

Gravitation.—As the particles of bodies attract each other, so bodies themselves, that is, masses of particles, attract each other. And this is true of all bodies whatever their size. Each body, according to the quantity of matter contained in it, draws every other towards it. The earth draws towards itself all lesser bodies around it; and these lesser bodies, again, draw the earth and one another. It is this attractive force which causes stones when unsupported to fall to the ground. It is this which, acting across the interval of ninety-five millions of miles, holds the earth as surely in her orbit as if she were connected by a chain with the sun; and the same force holds all the other planets in their orbits. It is called gravitation or gravity, and may be defined to be the force which causes all bodies to attract each other when they are at sensible distances apart.

When we perceive that all lesser bodies fall to the earth, while the earth never moves at all towards them, we may be ready to conclude that the force of gravitation belongs to the earth only, and not to the lesser bodies. But this would be an erroneous conclusion. The reason why a falling stone does not exert any perceptible force on the earth is, not that the earth has any special power which the stone has not, but merely that the earth, from its immense bulk, has so much greater attraction than the stone, that its motion towards the stone is too small to admit of observation or measurement. If the earth were no larger than the stone, the attraction between the two would be seen to be mutual; and if the earth were destroyed, or removed to a sufficient distance, the stones which you throw into the air, instead of falling to the ground as they now do, would be seen to draw themselves one to another. Owing to the nearness and great attractive power of the earth, we cannot prove, by experiment, that stones or other small bodies attract each other; yet we know that such is the case, because if, instead of taking a stone, we take a mountain, and hold a plumb-line near it, we find that the ball of the plumb-line is drawn slightly towards the mountain; showing clearly that an attraction *does* exist.

Under the action of gravity, bodies fall to the earth in lines perpendicular to the earth's surface, but not parallel to one another. The force of gravity acts, as it were, from the centre of the earth, and therefore draws all bodies in the direction of that centre. To us, indeed, the lines in which bodies fall seem to be parallel, because the height from which they fall is as nothing compared with the distance to the centre of the earth. But these lines must really converge; for the earth is a spherical body, and lines which fall perpendicular to the surface of a sphere cannot be parallel, because they would meet, if prolonged, in the centre of the sphere.



Gravitation causes all bodies, whether heavy or light, to fall *equally fast* to the earth. Such, indeed, does not seem at first sight to be the fact. A stone and a piece of paper do not occupy the same time in falling; a gold coin falls faster than a slip of gold leaf. But this difference in the time of falling is due to something quite apart from gravity—to something which, in the case of the lighter bodies, obstructs, and so far counteracts the force of gravity. It is due to the resistance or weight of the air. And, accordingly, whenever that resistance is excluded, it is found that the paper and the gold leaf fall equally fast with the stone, and the coin. Take a penny and a round piece of paper a trifle smaller in diameter than the penny. If you drop them side by side, the penny will go down first; but if you place the paper flat on the top of the coin so that it shall not meet with any resistance from the air, and then drop them, you will find that they both fall to the ground in the same time.

To the same counteracting cause is it owing that certain bodies, such as smoke and steam, rise instead of falling. The air near the earth is heavier than smoke or steam, and *hence, it not only* supports these light bodies, but forces them to rise till they reach a part of the atmosphere, the weight of which is not greater than their own. When you throw a piece of cork into a basin of water, why does it float on the surface? Doubtless, because being lighter than the water, it is supported by the water. When you pour more water into the basin why does the cork rise? Doubtless, because the water, being heavier than the cork, gets beneath the latter and obliges it to rise. In a similar manner are smoke and vapour forced upwards by the air,—though these bodies do not, like the cork, ascend to the surface of the fluid, but only to a region of air of their own density. Smoke, indeed, ascends but a very little way; it consists of minute particles of fuel carried up by the current of heated air from the fire below; and when this current of air is cooled by mixing with the atmosphere above, the minute particles of coal fall, and produce the small black flakes which render the air of towns so dirty.

Gravity, like cohesion, varies in power according to distance. If two bodies are placed a foot apart they attract each other with a certain power; if placed at a greater distance off they attract with less power; and if at a greater distance still, their attraction is still less. Thus, if a stone be let fall from the top of a high tower, the force of the earth's gravity, which acts upon it during the whole course of its descent, causes it to move quicker and quicker the longer it is in motion; whereas, if it be projected upwards, its ascent, being opposed by gravity, is constantly slower and slower, and finally ceases. The law of gravitation, with respect to distance, is, that two bodies attract each other *inversely as the square of the distance.* Thus, supposing a body to attract a stone with a certain power when the stone is one yard off, it will attract it at two yards off with four times less power (four being the square of two); and at three yards off with nine times less power (nine being the square of three). The discovery of this law has been of inestimable value to science, for it has enabled philosophers to calculate the distance and orbits of the planets—to foretell eclipses—to declare the law of the tides—and, in at least one instance, to announce the existence and place and orbit of a planet (Neptune) three thousand millions of miles distant, before any telescope had detected its presence in the heavens.

Chemical Affinity.—Since most bodies are composed of more than one kind of matter, they necessarily admit not only of being divided—that is, separated into their integrant parts—but also of being *decomposed* into their constituent elements. If you think of the difference between crumbling a loaf of bread into pieces, and separating the several ingredients of which it consists—the flour, the salt, and the water—you will be able to form some idea of the distinction between dividing a body and decomposing it. When we decompose a body, we separate its *constituent* elements; when, on the other hand, we divide a body by chopping it to pieces or even by grinding it to the finest powder, we merely separate its *integrant* parts; for each of these separated parts, however small, will still contain a portion of all the *constituent* elements of the body.

Now, *Chemical Affinity* is the force which draws and holds together the *constituent* elements of bodies, or, in other words, which effects all compositions and decompositions in bodies. And its operation will be best understood by comparing it, or rather contrasting it, with the force of cohesion.

The attraction of cohesion exists only between particles of the *same* nature, whether simple or compound. For example, it unites the particles of a piece of gold, which is a simple body, and the particles of a loaf of bread, which is a compound body. But Chemical Affinity unites, and maintains in a state of combination, particles of a *dissimilar* nature. It is this power that forms each of the compound particles of which bread consists; while it is by the attraction of cohesion that all these particles are connected into a single mass. And observe also that the attraction of cohesion unites particles of a similar nature without changing their original properties,—the result of such a union being always a body of the very same kind as the particles of which it is formed. On the other hand, chemical attraction, by combining particles of a dissimilar nature, produces compound bodies quite different from any of their separate constituents. If, for instance, I pour on the piece of copper contained in this glass some of this liquid (nitric acid), for which it has a strong chemical attraction or affinity, every particle of the copper will combine with a particle of the acid, and together the whole particles will form a new body totally different from either the copper or the acid. Do you observe the internal commotion which already begins to take place? It is produced by the combination of the copper and the acid; and yet the acid has in this case to overcome, not only the resistance which the cohesion of the particles of copper opposes to its combination with them, but also the weight of the copper, which keeps it at the bottom of the glass and prevents the acid from having such free access to it as if it were suspended in the liquid. The acid, however, in spite of these obstacles, is rapidly dissolving the copper; and you may already see how different this compound is from either of its ingredients. It is neither colourless like the acid, nor hard and reddish like the copper. If you tasted it you would no longer perceive the sourness of the acid. It has at present the appearance of a blue liquid; but when the union is completed, and the water evaporated with which the acid is diluted, the compound will assume the form of regular crystals of a fine blue colour, and perfectly transparent.

Not only does Chemical Affinity combine different substances into one compound body, it also effects the opposite process—it decomposes. And this it does in consequence of the greater affinity or preference which some substances have for one substance than for another. Let us call two ingredients of which a body is composed A and B. If we present to it another ingredient, C, which has a greater affinity for B than that which unites A and B, we shall find that B will quit A to combine with C. The new ingredient, C, therefore, effects a decomposition of the original body, A B; A is left alone, and a new compound, B C, is formed; just as two friends, happy in each other's society before the arrival of a third, are sometimes disunited by the preference of one of them for the new comer.

Suppose we wish to decompose the body which we have just formed by the combination of copper and nitric acid. We may do this by presenting to it a piece of iron, for which the acid has a stronger affinity than for copper. The acid will quit the copper to combine with the iron, and the copper will be *precipitated;* that is, it will be thrown down in a separate state, and reappear in its simple form. In order to produce this effect, I shall dip the blade of this knife into the fluid, and when I take it out you will observe that instead of being wetted with a bluish liquid like that contained in the glass, it will be covered with a thin coat of copper. The acid, quitting the copper, combines with the iron blade, and in so doing deposits or precipitates the copper on the surface of the blade.

Heat.—No one can exactly tell what Heat is—whether it be a distinct kind of matter interpenetrating other matter, or only a peculiar motion or condition of the particles of matter. But enough is known of its properties and effects to enable us to form some idea of its power and action as a physical force.

Apply heat to a solid body, such as a piece of lead or a block of ice, and what happens? If the heat is sufficiently great, the lead melts, and the ice becomes water. Continue to apply heat to the body thus liquefied, and yet another change ensues. The molten lead is changed into an invisible gas, and the water into steam. Heat, then, has the power of liquefying solid bodies, and of vaporizing liquid bodies.

It must be obvious, on reflection, that the way in which heat effects these changes is by weakening the force of cohesion. This iron rod has at present great strength, owing to the strong cohesive attraction of its particles; but if we make part of it redhot we shall find that that part will lose its strength and become soft; and we shall find also that the more it is heated, the weaker and softer it becomes. Yet what do such weakness and softness indicate, if not *this,* that the particles are no longer so close together as *they formerly* were, or, in other words, that the cohesion between them is weakened? Below a certain temperature, the force of cohesion preserves bodies in their solid form; and above a certain temperature its attraction is so lessened that bodies, according to the degree of heat applied to them, expand, become soft, turn liquid, or pass into vapour.

But cohesion is not the only force over which heat has power. It has also power over chemical affinity; for it can, in some instances, call the latter force into action, and, in other instances, overcome it. Thus, if a few pieces of quicklime and of ice be placed in contact, no chemical action takes place so long as the ice retains its solid condition; but if we apply heat sufficient to liquefy the ice, the quicklime will absorb the liquid water with great rapidity. This is an example of the power of heat in exciting the chemical force. And if we want an example of its power to overcome the same force, we have only to take the compound formed by the quicklime and water, and heat it to redness; for the effect of this new application of heat will be to decompose the compound and resolve it again into quicklime and water. Indeed, so great is the influence of heat in modifying chemical affinity, that without it we should never have been able to break up the chemical compounds which exist in nature, or to turn the science of chemistry to any practical use.

Electricity.—When certain substances, such as amber and sealing-wax, are rubbed with dry and warm flannel, they are found to attract feathers, fibres of cotton, paper, and other light bodies. The force which, by this simple means, is brought into action is called *Electricity*,—a name derived from the Greek word for amber (*electron*), because electrical phenomena were first noticed in that substance. In the "Arabian Nights' Entertainments," we read that Aladdin had only to rub his wonderful lamp in order to summon an almost omnipotent genie, who fulfilled his wildest desires. Some six hundred years B.C. the Greek philosopher, Thales of Miletus, by rubbing a piece of amber evoked an invisible agent, which has done for mankind far more wonderful things than the genie of Aladdin did or could have done for him.

Although electricity is believed to be a property common to all matter, yet, as in the case of heat, we are wholly ignorant of its nature. We know not whether it is a peculiar kind of matter or only a peculiar mode and condition of matter. But, in order to describe its phenomena, it is convenient to conceive of it as the former; and therefore it is usually spoken of even by those who prefer the latter belief, as a subtle and imponderable fluid which passes from bodies, and along and through bodies, in currents or streams. In bodies which do not exhibit electrical phenomena, it is supposed to exist in a latent or insensible state, hidden as it were in their substance and pores. Bodies, on the other hand, which manifest electrical phenomena—such as amber, shellac, glass, etc.—have this imponderable fluid set free at their surface in an active, sensible condition; so that it envelops them as a fog does a mountain-top, or flows over them as smoke does over the mast of a steamship, or flows through them as a current of warm water streams through a mass of cold. Electricity, as thus defined, is as invisible as common air; but when its intensity is high, it is cognizable by all the senses. It addresses the eye by its spark or lightning flash, the ear by its snap or thunder, the nostrils by a peculiar odour, the tongue by an equally peculiar taste, and the organs of touch by its characteristic shock.

Electricity differs from the other Physical Forces already described in being a dual force,—that is, in displaying itself in a twofold form. Yet duality is manifested only when the two electricities are parted. When the two meet, they neutralize and apparently annihilate each other. But in the act of becoming free, they separate into two forces, which, though identical in their nature, are opposite in the direction of their manifestation. To the two electricities the names have been given of *positive* and *negative*,—an unfortunate nomenclature, as it tends to convey the impression that the one is more positive or potent than the other; whereas the negative electricity has as positive an existence and as substantial powers as the opposite electricity,—and neither, in fact, can be produced without the development of the other.

To verify these statements, let us make a few simple experiments.

Let a little paper loop or stirrup be suspended by a fine thread, in such a way that a glass tube or a stick of sealing-wax may lie horizontally and move easily in it.

Put in the stirrup a glass rod or tube, after being rubbed with silk, and then bring near to one of its ends a stick of sealing-wax rubbed with flannel. What happens? The rubbed sealing-wax in your hand attracts the rubbed glass in the stirrup; or rather, the two mutually attract each other, (for in all cases of attraction, whether of cohesion, gravity, chemical affinity, or electricity, the body which attracts is attracted also). Or reverse the experiment by placing the rubbed sealing-wax in the stirrup, and bringing the rubbed glass near it. In this case also you will witness a similar attraction between the two. For while rubbed wax attracts rubbed glass, rubbed glass also attracts rubbed wax.

But now let your rubbed glass-tube be put in the stirrup, and the end of another rubbed glass-tube be brought near it. Do the two glass-tubes attract each other? No. There is repulsion instead of attraction; and so strong is the repulsion, that with the tube in your hand you can drive the tube in the stirrup round and round to any extent. And, in like manner, if you place your stick of rubbed sealing-wax in the loop, and bring near it another stick of rubbed sealing-wax, you will find that the two similarly repel each other. Whence you perceive that rubbed glass repels rubbed glass, and that rubbed wax repels rubbed wax.

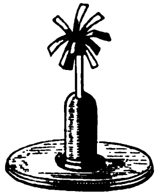
Instead of glass you might use any other of the vitreous bodies, and instead of wax you might use amber, shellac, rosin, sulphur, or any other resinous substance; and, on submitting them to experiment, you would always find that a vitreous body and a resinous body, when electrically excited by friction, mutually attract each other; but that a vitreous body repels a vitreous body, and a resinous a resinous.

The preceding experiments would seem to prove that there are two kinds of electricity—*vitreous* or *positive*, and *resinous* or *negative* electricity: the one developed by rubbing vitreous substances with silk, and the other by rubbing resinous substances with flannel. And they also show that positive and negative attract each other; while positive repels positive, and negative repels negative.

It is right, however, to mention that the existence of two kinds of electricity is not universally admitted. Some philosophers hold that there are not two distinct kinds, but only two different states of electricity. Hence they suppose that when a substance exhibits what is called positive electricity, it possesses *more* of the fluid than its ordinary proportion, and that when it exhibits negative electricity, it possesses *less* than its ordinary proportion. Thus, when glass is rubbed with a piece of silk, they suppose that some of the electricity contained in the silk is transferred to the glass, which then has more than its ordinary share; whilst the silk, having been deprived of part of its electricity, has less than its usual quantity. And in all cases where electricity passes suddenly from one body to another—as, for instance, from cloud to cloud in a thunder-storm—they explain the phenomena by saying that the one body is overcharged and the other undercharged, and that the temporary disturbance takes place in order to restore the electrical equilibrium.

But in whatever way the transference of the electric fluid from one body to another may be explained, there can be no dispute as to the fact of such transference. All the experiments which have just been performed, show that electricity passes from one substance to another. But it deserves notice that all bodies do not afford equal facilities for its passage. Some bodies permit it to pass along them or through them with the utmost ease, and some offer great resistance. The former are called *Conductors*, and the latter, *Non-conductors* or *Insulators*. The metals are good conductors; while the vitreous and resinous bodies are non-conductors. Silver is understood to be the best conductor, and shellac the best insulator. But no body is a perfect conductor or a perfect insulator. Under certain conditions, the very metals become, to some extent, non-conductors and insulators; and even air and the gases, which rank high among insulators, give way before an electrical current of great intensity,—though the strong resistance to be overcome is sufficiently evinced by the disruptive discharge which always occurs, as in the electric spark and in a flash of lightning.

The conductibility of this force through some bodies and not through others admits of being easily illustrated. Here, on this stand, is a glass rod with a pole of wood above it, and a paper tassel at the top of the pole. To show that the wood is a conductor, and the glass a non-conductor or insulator, we have only, by means of a wire, to connect the foot of the wooden pole with an electrical machine—that is, a machine for developing and transferring electricity. For as soon as the handle of the machine is turned, the electricity which is thereby evolved travels along the wire till it reaches the point where the glass and wood meet, and then, instead of passing down the glass, goes up the wood to the tassel, which it endows with such a power of repulsion that the strips of paper spread outwards in all directions.



Again, to show that the human body is a conductor, you have only to stand upon an insulator—for example, a stool with glass legs—in order to prevent the electricity from going away to the earth. Place yourself on such a stool, and receive the electric current from the machine; you forthwith feel that you are electrified, you feel your hair rising up as the paper tassel formerly did; and if there is near you a jet from which gas is issuing, you will probably be able to light the gas by merely touching the jet with your finger. It is thus demonstrable that this power of electricity can be transferred from the matter in which it is generated, and conducted along wire and other bodies, and thereby made to serve purposes unattainable by any of the forces previously described.

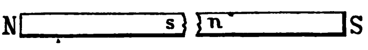
Of the vast power which this force can exert when in intense action, it must suffice for the present to say, that it is able to rend the oak of a hundred winters, to strike men and animals with instant death, to decompose the most intractable compounds, and in a very powerful manner to excite heat, light, and magnetism.

Magnetism, like Electricity, is a dual force, possessing the power both of attraction and of repulsion; but, unlike Electricity, it is not to be found in all bodies, but only in a few, and those chiefly iron and steel. Its manifestation was first observed in *Loadstone*—an ore of iron, which abounds in Sweden; and for centuries the remarkable property of attracting iron was supposed to be peculiar to that mineral. But it is now well ascertained that any piece of iron or steel has only to be rubbed with loadstone in order to acquire and exhibit the same powers as that natural magnet.

If an artificial magnet—that is, a bar or needle of steel which has acquired the magnetic property by being rubbed with loadstone—be suspended by the centre, so that it may move freely in all directions, one of its ends will be found to point towards the north, and the other towards the south. When left to itself, it invariably takes this position; and if you forcibly turn its north end southward or its south end northward, it will resume its original position whenever the constraining force is removed. This singular property is termed *polarity;* and the ends of the magnet are called, respectively, its north and its south *pole.* The direction which it takes is not, indeed, always exactly north and south, for there is what is called the *variation* of the needle—that is, a deviation, within certain limits, and according to a fixed law, to the west and east. In this country at present, the needle points considerably to the west of due north; in 1657, it pointed due north; previous to that period its variation had been on the east side of north; it then took a westerly direction; in 1814, it attained its greatest westward variation; and from that time till the present it has been slowly returning. Philosophers predict that in little more than a century hence it will again point due north.

In pointing north and south, a magnetized bar or needle does not maintain a horizontal position. The end which has a northerly direction always inclines downward, as if it were heavier than the opposite end, though there is, in reality, no difference in weight between the two. This descent of the north pole of the needle is owing to the greater nearness of that end of the needle to the north pole of the earth, and is termed the *dip.*

If two magnetized bars are freely suspended by their centres, and brought near each other, the north end of the one and the south end of the other mutually attract each other; while, on the other hand, the north pole of the one repels the north pole of the other, and the south pole of the one repels the south pole of the other. In this respect there is a striking analogy between the magnetic and the electric force; for in both cases the parts of a body which are in a similar state of excitement repel, and those which are in a dissimilar state attract. But are magnetic power and polarity confined to the two ends or extremities of a magnetized bar? At first sight this might seem to be the case, for, in point of fact, the *middle* of the bar does neither attract nor repel the magnet which you bring near it: only towards its extremities does the bar manifest any force. But in reality the magnetic force is not thus limited. It resides in every part and throughout the whole mass, though exhibited only at or near the extremities. And all we have to do to prove this is to break the bar in two. The moment this is done, it will be found that the two new ends formed by the fracture display magnetic power and polarity as really as the original ends of the bar —the one showing the properties of a south pole and the other the properties of a north pole.



It has been already said that any piece of iron or steel may be magnetized by merely rubbing it with loadstone. But this is not the only method of magnetization. An artificial magnet has, equally with the loadstone, the power of communicating magnetism, and that by contact alone, without the process of rubbing. If a small bar of steel remains a short time in contact with any artificial magnet, and is then removed, it will be found to have acquired permanent magnetism. If a small bar of iron is similarly treated, a like result will ensue, but with this difference, that, on being removed, it parts with its temporary magnetism and returns to its unmagnetic condition. The iron readily receives the magnetic energy, and as readily parts with it; but the steel is slow to receive, and tenacious in retaining it. Once duly magnetized, bars of steel will act as magnets for many years, and, singular to say, will have their energy rather increased than diminished by their being used in communicating it to others. Indeed, a magnet, whether natural or artificial, never loses by imparting magnetism: it rather gains,—differing in this respect from electrization, which never takes place without causing one body to lose what another body gains.

The earth itself is a magnetizer. If an iron poker is held in the position of the *dip*, and struck sharply, its lower end will show signs of north polarity, and its upper end of south; and, so long as it is kept in this position, it will retain its magnetic energy. A steel poker, owing to its greater resistance to the reception of magnetism, is not polarized with the same facility as an iron one. Yet even steel bars have been magnetized by the magnetic influence of the earth.

Of all magnetizers, however, the most powerful is electricity. And, what is remarkable, this force not only communicates magnetic properties to iron and steel, but imparts new properties to these bodies after they are magnetized. For example: If a magnetic needle is brought near a wire which is traversed by a current of voltaic electricity, the effect of the electric current upon the needle is to turn it out of its ordinary line of magnetic direction, and cause it to arrange itself *across* the wire. Before the current reaches it, the needle points from north to south; but the moment it is brought within the influence of the current, it points west and east; nor is it till the current ceases that it resumes its natural position. It is this flitting from side to side of the needle at the bidding of the electric current which has rendered it practicable to convey messages by the Electric Telegraph. The motions of the needles right and left, and the number of their oscillations, are made, by previous agreement, to represent letters, figures, and words. And thus two or more persons are enabled to communicate with each other, without regard to distance, and with as much accuracy as if they were talking face to face.

It need scarcely be said, that the *Mariner's Compass* owes its uses to the power of Magnetism. That invaluable instrument consists of a magnetized needle of steel, poised freely on its centre so as to enable it always to point towards the north. To the upper side of the magnet is attached, so as to move round with it, a card, with the four cardinal, and twenty-eight intermediate, points marked upon it. The magnet and card are enclosed in a circular brass box covered above with glass; and the box itself is suspended on gimbals, to prevent the card from being thrown off its horizontal position by the motion of the ship.

Compiled chiefly from FARADAY.

QUOTATIONS FROM SHAKSPEARE.

HEAVEN doth with us as we with torches do:
Not light them for themselves: for if our virtues
Did not go forth of us, 'twere all alike
As if we had them not. Spirits are not finely touched,
But to fine issues. Nature never lends
The smallest scruple of her excellence;
But, like a thrifty goddess, she determines
Herself the glory of a creditor,
Both thanks and use.

OUR revels now are ended: these our actors,
As I foretold you, were all spirits, and
Are melted into air, into thin air:
And, like the baseless fabric of this vision,

The cloud-capped towers, the gorgeous palaces,
The solemn temples, the great globe itself,
Yea, all that it inherit, shall dissolve,
And, like an insubstantial pageant faded,
Leave not a rack behind.

THE poet's eye, in a fine frenzy rolling,
Doth glance from heaven to earth, from earth to heaven;
And, as imagination bodies forth
The forms of things unknown, the poet's pen
Turns them to shape, and gives to airy nothing
A local habitation and a name.

AND this our life, exempt from public haunts,
Finds tongues in trees, books in the running brooks,
Sermons in stones, and good in everything.

WHAT stronger breastplate than a heart untainted?
Thrice is he armed that hath his quarrel just,
And he but naked, though locked up in steel,
Whose conscience with injustice is corrupted.

THE quality of mercy is not strained;
It droppeth, as the gentle rain from heaven
Upon the place beneath: it is twice blessed;
It blesseth him that gives, and him that takes:
'Tis mightiest in the mightiest; it becomes
The throned monarch better than his crown:
His sceptre shows the force of temporal power,
The attribute to awe and majesty,
Wherein doth sit the dread and fear of kings;
But mercy is above this sceptred sway,
It is enthroned in the hearts of kings,
It is an attribute to God himself;
And earthly power doth then show likest God's
When mercy seasons justice.

How sweet the moonlight sleeps upon this bank!
Here will we sit, and let the sounds of music
Creep in our ears; soft stillness, and the night,
Become the touches of sweet harmony.
Sit, Jessica: look how the floor of heaven
Is thick inlaid with patines of bright gold;
There's not the smallest orb, which thou behold'st

But in his motion like an angel sings,
Still choiring to the young-eyed cherubims!

My way of life
Is fallen into the sear, the yellow leaf:
And that which should accompany old age,
As honour, love, obedience, troops of friends,
I must not look to have; but, in their stead,
Curses, not loud, but deep, mouth-honour, breath,
Which the poor heart would fain deny, and dare not.

Can'st thou not minister to a mind diseased;
Pluck from the memory a rooted sorrow;
Raze out the written troubles of the brain;
And, with some sweet oblivious antidote,
Cleanse the stuffed bosom of that perilous stuff
Which weighs upon the heart?

To gild refined gold, to paint the lily,
To throw a perfume on the violet,
Is wasteful and ridiculous excess.

There is some soul of goodness in things evil,
Would men observingly distil it out.

Suspicion always haunts the guilty mind;
The thief doth fear each bush an officer.

Good name in man or woman, dear my lord,
Is the immediate jewel of their souls:
Who steals my purse steals trash; 'tis something, nothing;
'Twas mine, 'tis his, and has been slave to thousands;
But he that filches from me my good name,
Robs me of that which not enriches him,
And makes me poor indeed.

This Cardinal,
Though from an humble stock, undoubtedly
Was fashioned to much honour from his cradle.
He was a scholar, and a ripe and good one;
Exceeding wise, fair spoken, and persuading;
Lofty and sour to them that loved him not;
But, to those men that sought him sweet as summer;

And though he were unsatisfied in getting
(Which was a sin), yet in bestowing, madam,
He was most princely. Ever witness for him
Those twins of learning that he raised in you,
Ipswich and Oxford! one of which fell with him,
Unwilling to outlive the good that did it;
The other, though unfinished, yet so famous,
So excellent in art, and still so rising,
That Christendom shall ever speak his virtue.

SECTION II.

HOW IT STRIKES A STRANGER.

In a remote period of antiquity, when the marvellous obtained a readier credence than now, it was fabled that a stranger of extraordinary appearance was observed pacing the streets of one of the cities of the East, and attentively examining every surrounding object. The curiosity of the inhabitants regarding him remained for a time unsatisfied, owing to his ignorance of their language; but when at length he understood by their signs that they wished to be informed whence he came, he pointed with great significance to the sky; upon which the crowd, concluding him to be one of their deities, were proceeding to pay him divine honour; but he no sooner comprehended their design than he rejected it with horror, and, bending his knees, and raising his hands towards heaven in the attitude of prayer, gave them to understand that he also was a worshipper of the powers above.

After a time, it is said that the mysterious stranger accepted the hospitalities of one of the nobles of the city, under whose roof he applied himself to the acquirement of the language, in which he made such surprising proficiency that in a few days he was able to hold intelligent intercourse with those around him. The noble host now resolved to take an early opportunity of satisfying his curiosity respecting the country and quality of his guest; and, upon his expressing this desire, the stranger assured him that he would answer his inquiries that evening after sunset. Accordingly, as night approached, he led him forth upon the balconies of the palace which overlooked the wealthy and populous city. Innumerable lights from its busy streets and splendid palaces were now reflected in the dark bosom of its noble river, where stately vessels, laden with rich merchandise from all parts of the known world, lay anchored in the port. The stranger mused a while upon the glittering scene. Then suddenly raising his eyes to the starry firmament, he fixed them, with an expressive gaze, on the beautiful evening star. "Marvel not," said he to his host, "that I gaze with fond affection on yonder silvery star. I was lately an inhabitant of that tranquil planet. Often had I beheld with admiration this brilliant world of yours, ever one of the brightest gems of our firmament; and the ardent desire I had long felt to know something of its condition was at length unexpectedly gratified. I received permission and power to traverse the mighty void, and to direct my course to this distant sphere. To that permission, however, one condition was annexed, to which my eagerness for the enterprise induced me hastily to consent; namely, that I must thenceforth remain an inhabitant of this earth, and undergo all the vicissitudes to which its natives are subject. Tell me, therefore, I pray you, what is the lot of man; and explain to me more fully than I yet understand all that I hear and see around me."

"Truly, sir," replied the astonished noble, "although I am altogether unacquainted with the products and privileges of your country, yet I cannot but congratulate you on your arrival in our world, especially since it has been your good fortune to alight on a part of it affording such varied sources of enjoyment as this opulent city. And, be assured, it will be my pride and pleasure to introduce you to all that is most worthy the attention of such a distinguished foreigner."

Our adventurer, accordingly, was presently initiated in those arts of luxury and pleasure which were there well understood. He was introduced, by his obliging host, to their public games and festivals, to their theatrical diversions and convivial assemblies; and he was just beginning to be in some measure reconciled to the manners and customs of our planet when an incident occurred which gave an entirely new direction to his energies. It was but a few weeks after his arrival on our earth, when, walking with his friend in the outskirts of the city, his attention was arrested by the appearance of a spacious enclosure near which they passed. He inquired the use to which it was appropriated.

"It is," replied the nobleman, "a place of public interment."—"I do not understand you," said the stranger.—"It is the place," repeated his friend, "where we bury our dead."—"I am still at a loss to comprehend you," said the stranger; "this must relate to something of which I was totally ignorant in my own world."—"My good friend," replied the nobleman, "you must be indeed a novice amongst us, if you have yet to learn that we must all, sooner or later, submit to take our place in these dismal abodes; nor will I deny that it is one of the least desirable of the circumstances which appertain to our condition. But, truly, sir, if the inhabitants of the place whence you came are not liable to any similar misfortune, I advise you to betake yourself back again with all speed; for be assured there is no escape here; nor could I guarantee your safety for a single hour."

"Alas!" replied the adventurer, "I must submit to the conditions of my enterprise, of which, till now, I little understood the import. But explain to me, I beseech you, something more of the nature and consequences of this wondrous metamorphosis, and tell me at what period it most commonly happens to man." While he thus spoke his voice faltered, and his whole frame trembled. His companion, finding the discourse becoming more serious than was agreeable, declared that he must refer him to the priests for further information, this subject being very much out of his province. "How!" exclaimed the stranger, "then I cannot have understood you:—do only the priests die?—are not you to die also?" His friend, evading these questions, hastily conducted his importunate companion to one of their magnificent temples, where he gladly consigned him to the instructions of the priesthood.

The emotion which the stranger had betrayed when he received the first idea of death was slight in comparison with that which he experienced as soon as he gathered from the discourses of the priests some notion of immortality, and of the alternative of happiness or misery in a future state. But this agony of mind was exchanged for transport when he learned that, by the performance of certain conditions before death, the state of happiness might be secured. His eagerness to learn the nature of these terms excited the surprise and even the contempt of his sacred teachers. They advised him to remain satisfied for the present with the instructions he had received, and to defer the remainder of the discussion till the morrow. "How!" exclaimed the novice, "say you not that death may come at any hour?—may it not then come this hour?—and what if it should come before I have performed these conditions! Oh! withhold not this excellent knowledge from me a single moment!"

The priests then proceeded to explain their Theology to their attentive auditor; but who shall describe the ecstasy of his happiness when he was given to understand that the required conditions were, generally, of easy and pleasant performance, and that the occasional difficulties or inconveniences which might attend them would entirely cease with the short term of his earthly existence!

From that period, continues the legend, the stranger devoted himself to the performance of those conditions on which he was told his future welfare depended. If ever he was tempted for a moment to violate any of them, he bewailed his own madness with agonizing emotions; and to all the invitations he received from others to do anything inconsistent with his real interests, he had but one answer,—"Oh," he would say, "I am to die!—I am to die!"

JANE TAYLOR.

DEATH.

  Leaves have their time to fall,
And flowers to wither at the north wind's breath,
  And stars to set;—but all,
Thou hast *all* seasons for thine own, O Death!

  Day is for mortal care,
Eve for glad meetings round the joyous hearth,
  Night for the dreams of sleep, the voice of prayer—
But all for thee, thou Mightiest of the Earth!

  Youth and the opening rose
May look like things too glorious for decay,
  And smile at thee; but thou art not of those
Who wait the ripened bloom to seize their prey.

  We know when moons shall wane,
When summer birds from far shall cross the sea,
  When Autumn's hue shall tinge the golden grain;
But who shall teach us when to look for thee?

  Is it when Spring's first gale
Comes forth to whisper where the violets lie?
  Is it when roses in our paths grow pale?
They have one season—*all* are ours to die!

  Thou art where billows foam,
Thou art where music melts upon the air,
  Thou art around us in our peaceful home,
And the world calls us forth—and thou art there!

  Thou art where friend meets friend,
Beneath the shadow of the elm to rest;
  Thou art where foe meets foe, and trumpets rend
The skies, and swords beat down the princely crest.

  Leaves have their time to fall,
And flowers to wither at the north wind's breath,
  And stars to set;—but all,
Thou hast *all* seasons for thine own, O Death!

Mrs Hemans.

THE path by which we twain did go,
Which led by paths that pleased us well.
Through four sweet years arose and fell,
From flower to flower, from snow to snow:

And we with singing cheered the way,
And, crowned with all the season lent,
From April on to April went,
And glad at heart from May to May.

But where the path we walked began
To slant the fifth autumnal slope,
As we descended following Hope,
There sat the Shadow feared of man;

Who broke our fair companionship,
And spread his mantle dark and cold,
And wrapped thee formless in the fold,
And dulled the murmur on thy lip,

And bore thee where I could not see
Nor follow, though I walk in haste,
And think, that somewhere in the waste
The Shadow sits and waits for me.

TENNYSON.

STRANGER, however great,
With holy reverence bow;
There's one in that poor shed,
One by that paltry bed,
Greater than thou.

Beneath that beggar's roof,
Lo! Death doth keep his state;
Enter—no crowds attend;
Enter—no guards defend
This palace gate.

That pavement, damp and cold,
No smiling courtiers tread;
One silent woman stands,
Lifting with meagre hands
A dying head.

No mingling voices sound—
An infant wail alone;
A sob suppressed—again
That short, deep gasp, and then—
The parting groan.

Oh! change—stupendous change!
There lies the soulless clod;
The sun eternal breaks—
The new immortal wakes—
Wakes with his God! MRS SOUTHEY.

ROCKS AND THEIR ARRANGEMENT.

THE term Rocks is applied by mineralogists, not only to those hard stony substances which are popularly so called, but to all the mineral substances, whether hard or soft, which compose the crust of the earth.

Rocks are seldom *simple* bodies—that is, bodies made up entirely of one mineral. With few exceptions, they are all *compound* bodies, made up of two or more minerals combined in various proportions and conditions.

Rocks have been classified into the three great divisions of Igneous, Aqueous, and Metamorphic. The *Igneous* rocks are those which are supposed to have once been melted by excessive heat, and to have cooled down from that fused state into the condition in which we now find them. The *Aqueous* are those which are supposed to have been formed by the tranquil deposition under water of the mineral substances of which they are composed; while the term *Metamorphic* is applied to rocks which show indications of having been originally formed under water, but afterwards modified by the action of heat. The chief rocks of igneous origin are — granite, syenite, porphyry, greenstone, and basalt; the chief aqueous rocks are—limestone, sandstone, clay, and clay-slate; among the metamorphic rocks, the most remarkable are gneiss and mica-schist.

There is a marked difference in texture between the igneous and the aqueous rocks. The former are close-grained and crystalline; while the latter always exhibit a stratified form

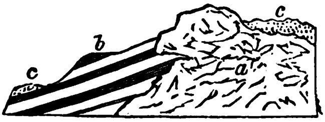
—that is, a form in which the materials are arranged in regular layers or strata. On account of this diversity in texture, the igneous are called *Unstratified*, and the aqueous *Stratified* rocks.

The theory that the earth's crust was formed, not all at once, but in successive portions and at successive periods, would seem to be verified, or at least supported, by the regular order in which the rocks overlie one another, as well as by the distinctive structure and composition of each group in the series.

The undermost part of the earth's crust often consists of granite and other unstratified rocks, all of which indicate, by their agglutinated texture and their unworn and angular crystals, that they were originally in a state of fusion. Immediately above this granitic mass are the metamorphic rocks, which likewise have a crystalline texture. The granitic and metamorphic rocks further resemble each other, in being what is called *unfossiliferous*—that is, in containing no fossils, no organic remains; a fact which also accords with the idea of fusion by heat.

Above this hard granitic and metamorphic basis the stratified rocks rise in an ascending series, comprehending three groups, which have the names of the Palæozoic, the Secondary, and the Tertiary rocks. The *Palæozoic* group, which is supposed to be next in age to the metamorphic, comprises the silurian rocks, the old red-sandstone, and the coal-measures. Here the crystalline texture, characteristic of the previous rocks, disappears, and a stratified texture takes its place, showing the operation, not of igneous, but of aqueous influences. Here also, as the name Palæozoic implies, we find the first traces of organic being. Fossils are abundant in the old red-sandstone; and in the coal-measures, vegetable remains form the chief and peculiar ingredient. The *Secondary* rocks, like the Palæozoic, comprehend three systems—the new red-sandstone, the oolite, and the chalk. All these systems are fossiliferous; and it is in the oolite that we find the remains of those gigantic reptiles whose strange forms at once amaze the ignorant and interest the curious. The Tertiary group presents us with organic remains not very dissimilar from the living creatures of our own era; for though the animals are often distinct from any with which we are now familiar, yet in structure they are allied to existing species. Judging from the rocks and their contents, the physical condition of the earth during the tertiary period cannot have very widely differed from its present condition.

The preceding description may help to convey some idea of the order in which the series of rocks which compose the crust of the earth were originally formed and arranged. The actual structure of the earth's crust, however, is something very different from that now described. The earth's crust is no longer "a granite nucleus surrounded by entire concentric coverings of stratified rocks like the coats of an onion." A great change has taken place in the position of many of the rocks. The earliest rocks are not always found lowest, nor the latest rocks highest. Some igneous rocks are found at the summit, instead of the bottom of the crust; and some aqueous rocks, in place of lying horizontally as at first, run obliquely in every direction. The fact would seem to be, that the igneous agencies concerned in the production of the unstratified rocks, did not cease to operate when these rocks had been formed, but continued at work during the gradual and successive depositions of the stratified rocks, breaking up and dislocating the superincumbent strata, and forcing upwards large portions of the granitic mass. Under the action of such disturbing forces, it was inevitable that the igneous rocks should, to some extent, be lifted from their original position at the base of the crust, and thrown up, in the shape of mountains and hills, through and above the stratified rocks; and it was equally inevitable that the stratified rocks, acted upon by volcanic agencies from below, should lose their horizontal position, and, in some instances, suffer disruption.



a, Unstratified rocks.
b, Stratified rocks.
c, Superficial deposits.

But it must not be supposed that the crust of the earth, though thus in various parts disrupted and disarranged, is now a scene of disorder. Though the stratified rocks no longer retain their horizontal position, but range in almost every direction, yet they are never found tossed hither and thither at random. They are always found in the order in which they were progressively formed. Everywhere, for example, the silurian rocks rest on the metamorphic and the old red-sandstone on the silurian. We never find the coal-measures above the new red-sandstone, nor the chalk below the oolite. An orderly arrangement is everywhere discernible. Nor is it any disadvantage to the earth, considered as an abode for man, that the granitic rocks have been made to upheave and pierce the stratified rocks, so as to place both themselves and the latter, either on the earth's surface, or nearer it than before. It is, on the contrary, a great advantage. Apart from such upheaval and dislocation, the hard rocks, so valuable for architectural purposes, would have been beyond our reach; the metals would have remained for ever concealed in their native crypts; coal would have lain at an inaccessible depth; there would have been no hollows to contain the ocean, and no mountain-tops to attract the clouds. And where would have been our beautiful variety of hill and valley, of glen and stream? The earth's surface would have been a mere uniform level, without life or picturesqueness; its rivers mere sluggish canals; its whole aspect destitute of that mingled sweetness and grandeur which now makes it so glorious a mirror of Power, and Wisdom, and Goodness. *Compiled.*

THE LONG LIFE OF BOOKS.

THERE are two aspects under which we may regard language as a channel for communicating instruction and pleasure. One is *Speech*. How astonishing is it that a man may stand in the crowd of learned or ignorant, thoughtful or reckless hearers, and knock at the door of each heart in succession! Think *how this wonder* has been wrought already;—by

Demosthenes waving the stormy democracy into a calm, from a sunny hillside; by Plato enchaining the souls of his disciples, under the boughs of a dim plane-tree; by Cicero in the stern silence of the Forum; by our own Chatham in the chapel of St. Stephen. They knocked and entered; wandered through the bosoms of their hearers; and aroused the passions in their lone concealment. The Athenian populace started up with one accord and one cry to march upon Philip; the Senate throbbed with indignation at Cataline; and the British Parliament was dissolved for a few hours, that it might recover from the wand of the enchanter.

But it is in the second manifestation of language that the most marvellous faculty resides. The *Written* outlives and outdazzles the spoken word. The life of rhetoric perishes with the rhetorician; it darkens with his eye, stiffens with his hand, freezes with his tongue. The bows of eloquence are buried with the archers. But literature is the immortality of speech. It embalms for all ages the departed kings of learning, and watches over their repose in the eternal pyramids of Fame. The sumptuous cities which have lighted the world since the beginning of time are now beheld only in the pictures of the historian or the poet. Homer rebuilds Troy, and Thucydides renews the war of the Peloponnesus. The dart that pierced the Persian breastplate moulders in the dust of Marathon; but the arrow of Pindar quivers, at this hour, with the life of his bow.

We look with grateful eyes upon this preservative power of literature. When the Gothic night descended over Europe, Virgil and Livy were nearly forgotten and unknown; but far away, in lone corners of the earth amid silence and shadow, the ritual of genius continued to be solemnized. Without, were barbarian, storm, and darkness; within, light, fragrance, and music. So the sacred fire of Learning burnt upon its scattered shrines, until torch after torch carried the flame over the world.

Art has been less happy in its self-protection. Fifty years ago, observers complained that the colour was gone from the "Cornaro Family" of Titian. The Helen of Homer and the Faëry Queen of Spenser are safe from such a catastrophe. The coarsest rubbings of critical pens have left the features, and even the bloom of expression, unimpaired.

It is not pretended that the genius of the pen is safe from all casualties that beset his brother of the pencil. I have not forgotten Hume's letter to Robertson about the gentleman who, sending for a pound of raisins, received them wrapped up in the Doctor's highly-drawn character of Queen Elizabeth. Literature has its complaint as well as its pæan. The splendid libraries of Rome are consumed by fire, and the unknown treasures of Greece perish in the sack of Constantinople. Still the poet and the historian maintain their supremacy over the artist and the sculptor. A mob shatters into dust that statue of Minerva whose limbs seem to breathe under the flowing robe, and her lips to move; but the fierceness of the Goth, the ignorance of the Crusader, and the frenzy of the polemic, have not destroyed or mutilated Penelope and Electra. Apelles dies; Æschylus lives.

WILLMOTT.

THE SAXON AND THE GAEL.

So toilsome was the road to trace,
The guide, abating of his pace,
Led slowly through the pass's jaws,
And asked Fitz-James, by what strange cause
He sought these wilds, traversed by few,
Without a pass from Roderick Dhu?

"Brave Gael, my pass, in danger tried,
Hangs in my belt, and by my side:
Yet, sooth to tell," the Saxon said,
"I dreamt not now to claim its aid.
When here, but three days since, I came,
Bewildered in pursuit of game,
All seemed as peaceful and as still
As the mist slumbering on yon hill;
Thy dangerous Chief was then afar,
Nor soon expected back from war."—
"But, stranger, peaceful since you came,
Bewildered in the mountain game,

Whence the bold boast by which you show
Vich-Alpine's vowed and mortal foe?"—
"Warrior, but yestermorn, I knew
Nought of thy Chieftain, Roderick Dhu,
Save as an outlawed desperate man,
The Chief of a rebellious clan,
Who, in the Regent's court and sight,
With ruffian dagger stabbed a knight:
Yet this alone might from his part
Sever each true and loyal heart."
Wrothful at such arraignment foul,
Dark lowered the clansman's sable scowl:
A space he paused, then sternly said,
"And heardst thou why he drew his blade?
Heardst thou that shameful word and blow
Brought Roderick's vengeance on his foe?
What recked the Chieftain if he stood
On Highland heath, or Holy-Rood?"

"Well, let it pass; nor will I now
Fresh cause of enmity avow,
To chafe thy mood and cloud thy brow.
Enough, I am by promise tied
To match me with this man of pride:
Twice have I sought Clan-Alpine's glen
In peace; but when I come agen,
I come with banner, brand, and bow,
As leader seeks his mortal foe;
For love-lorn swain, in lady's bower,
Ne'er panted for the appointed hour,
As I, until before me stand
This rebel Chieftain and his band!"

"Have, then, thy wish!"—He whistled shrill,
And he was answered from the hill;
Wild as the scream of the curlew,
From crag to crag the signal flew.
Instant, through copse and heath, arose
Bonnets, and spears, and bended bows;
On right, on left, above, below,
Sprung up at once the lurking foe;
From shingles gray their lances start,
The bracken-bush sends forth the dart,
And every tuft of broom gives life
To plaided warrior armed for strife.

That whistle garrisoned the glen
At once with full five hundred men,
As if the yawning hill to heaven
A subterranean host had given.
Watching their leader's beck and will,
All silent there they stood, and still.
Like the loose crags, whose threatening mass
Lay tottering o'er the hollow pass,
As if an infant's touch could urge
Their headlong passage down the verge,
With step and weapon forward flung,
Upon the mountain-side they hung.
The Mountaineer cast glance of pride
Along Benledi's living side,
Then fixed his eye and sable brow
Full on Fitz-James—"How sayest thou now?
These are Clan-Alpine's warriors true;
And, Saxon,—I am Roderick Dhu!"

Fitz-James was brave:—Though to his heart
The life-blood thrilled with sudden start,
He manned himself with dauntless air,
Returned the Chief his haughty stare,
His back against a rock he bore,
And firmly placed his foot before:—
"Come one, come all! this rock shall fly
From its firm base as soon as I."
Sir Roderick marked—and in his eyes
Respect was mingled with surprise,
And the stern joy which warriors feel
In foemen worthy of their steel.
Short space he stood—then waved his hand:
Down sunk the disappearing band;
Each warrior vanished where he stood,
In broom or bracken, heath or wood;
It seemed as if their mother Earth
Had swallowed up her warlike birth.
The wind's last breath had tossed in air
Pennon, and plaid, and plumage fair,—
The next but swept a lone hill-side,
Where heath and fern were waving wide.

Fitz-James looked round—yet scarce believed
The witness that his sight received;

Sir Roderick in suspense he eyed,
And to his look the Chief replied,—
"Fear nought—nay, that I need not say—
But—doubt not aught from mine array.
Thou art my guest;—I pledged my word
As far as Coilantogle ford:
So move we on;—I only meant
To show the reed on which you leant,
Deeming this path you might pursue
Without a pass from Roderick Dhu."

SIR WALTER SCOTT—*Lady of the Lake.*

THE SAXON AND THE GAEL CONTINUED.

THE Chief in silence strode before,
And reached that torrent's sounding shore,
Which, daughter of three mighty lakes,
From Vennachar in silver breaks,
Sweeps through the plain, and ceaseless mines
On Bochastle the mouldering lines,
Where Rome, the Empress of the World,
Of yore her eagle wings unfurled.
And here his course the Chieftain staid,
Threw down his target and his plaid,
And to the Lowland warrior said:—
"Bold Saxon! to his promise just,
Vich-Alpine has discharged his trust.
This murderous Chief, this ruthless man,
This head of a rebellious clan,
Hath led thee safe, through watch and ward,
Far past Clan-Alpine's outmost guard.
Now, man to man, and steel to steel,
A Chieftain's vengeance thou shalt feel.
See, here, all vantageless I stand,
Armed, like thyself, with single brand:
For this is Coilantogle ford,
And thou must keep thee with thy sword."

The Saxon paused:—"I ne'er delayed,
When foeman bade me draw my blade;
Nay more, brave Chief, I vowed thy death:
Yet sure thy fair and generous faith,

And my deep debt for life preserved,
A better meed have well deserved:
Can nought but blood our feud atone,
Are there no means?"—"No, stranger, none!
And hear,—to fire thy flagging zeal,—
The Saxon cause rests on thy steel;
For thus spoke Fate by prophet bred
Between the living and the dead;
'Who spills the foremost foeman's life,
His party conquers in the strife.'"—
"Then, by my word," the Saxon said,
"The riddle is already read.
Seek yonder brake beneath the cliff,—
There lies Red Murdoch stark and stiff.
Thus Fate has solved her prophecy,
Then yield to Fate, and not to me.
To James, at Stirling, let us go,
When, if thou wilt be still his foe,
Or if the King shall not agree
To grant thee grace and favour free,
I plight mine honour, oath, and word,
That, to thy native strengths restored,
With each advantage shalt thou stand,
That aids thee now to guard thy land."

Dark lightning flashed from Roderick's eye—
"Soars thy presumption, then, so high,
Because a wretched kern ye slew,
Homage to name to Roderick Dhu?
He yields not, he, to man nor Fate!
Thou add'st but fuel to my hate:—
My clansman's blood demands revenge.
Not yet prepared for fight?—I change
My thought, and hold thy valour light
As that of some vain carpet-knight,
Who ill deserved my courteous care,
And whose best boast is but to wear
A braid of his fair lady's hair."
—"I thank thee, Roderick, for the word!
It nerves my heart, it steels my sword;
For I have sworn this braid to stain
In the best blood that warms thy vein.
Now, truce, farewell! and, ruth, begone!—

Yet think not that by thee alone,
Proud Chief! can courtesy be shown;
Though not from copse, or heath, or cairn,
Start at my whistle clansmen stern,
Of this small horn one feeble blast
Would fearful odds against thee cast.
But fear not—doubt not—which thou wilt—
We try this quarrel hilt to hilt."—

Then each at once his falchion drew,
Each on the ground his scabbard threw,
Each looked to sun, and stream, and plain,
As what they ne'er might see again;
Then foot, and point, and eye opposed,
In dubious strife they darkly closed.
Ill fared it then with Roderick Dhu,
That on the field his targe he threw,
Whose brazen studs and tough bull-hide
Had death so often dashed aside;
For, trained abroad his arms to wield,
Fitz-James's blade was sword and shield.
He practised every pass and ward,
To thrust, to strike, to feint, to guard;
While less expert, though stronger far,
The Gael maintained unequal war.
Three times in closing strife they stood,
And thrice the Saxon blade drank blood;
No stinted draught, no scanty tide,
The gushing flood the tartans dyed.
Fierce Roderick felt the fatal drain,
And showered his blows like wintry rain;
And, as firm rock or castle roof,
Against the winter shower is proof,
The foe, invulnerable still,
Foiled his wild rage by steady skill;
Till, at advantage ta'en, his brand
Forced Roderick's weapon from his hand,
And, backward borne upon the lea,
Brought the proud Chieftain to his knee.

"Now, yield thee, or"—the Saxon said,
"Thy heart's blood, Chieftain, dyes my blade!"—
"Thy threats, thy mercy, I defy!
Let recreant yield, who fears to die."

—Like adder darting from his coil,
Like wolf that dashes through the toil,
Like mountain-cat who guards her young,
Full at Fitz-James's throat he sprung;
Received, but recked not of a wound,
And locked his arms his foeman round.—
Now, gallant Saxon, hold thine own!
No maiden's hand is round thee thrown!
That desperate grasp thy frame might feel
Through bars of brass and triple steel!
They tug, they strain! down, down they go,
The Gael above, Fitz-James below.
The Chieftain's gripe his throat compressed;
His knee was planted in his breast;
His clotted locks he backward threw,
Across his brow his hand he drew,
From blood and mist to clear his sight,
Then gleamed aloft his dagger bright!
—But hate and fury ill supplied
The stream of life's exhausted tide;
And all too late the advantage came,
To turn the odds of deadly game;
For, while the dagger gleamed on high,
Reeled soul and sense, reeled brain and eye.
Down came the blow! but in the heath
The erring blade found bloodless sheath.
The struggling foe may now unclasp
The fainting Chief's relaxing grasp;
Unwounded from the dreadful close,
But breathless all, Fitz-James arose. *Id.*

LAND AND WATER.

When you cast your eyes over a map of the world, you perceive that it consists of one vast ocean, in which two large and many small islands are placed. There is, properly speaking, only one sea, which covers about seven-tenths of the surface of the earth. Convenience, however, has recommended a division of this sea; and accordingly it is usually divided into five portions, viz. the Pacific Ocean, the *Atlantic, the Arctic,* the Antarctic, and the Indian

Oceans. But the whole expanse may also be regarded as consisting of only two great Basins, the Eastern and the Western—the former including the Pacific and the Indian Oceans, with their several gulfs and inland seas; and the latter, the Atlantic, with its contiguous seas and gulfs. According to this division, the Arctic and Antarctic Oceans belong partly to the Eastern and partly to the Western Basin.

The form of the Western Basin is that of a great channel narrowing towards the poles, and flanked on both sides by projections of land and inland seas, that bear a close resemblance to each other. The situation of Britain and the adjoining coasts on the one side, closely resembles that of Newfoundland and the adjacent shore on the other; the peninsula of Spain resembles that of Florida; the coast of Upper Guinea that of Brazil; and the shores of Africa those of South America. The Baltic and Northern Seas correspond to Baffin's and Hudson's Bays; the Mediterranean Sea to the Gulf of Mexico. With respect to the Eastern Basin, one singular fact may be mentioned. It is surrounded, or nearly so, by a chain of mountains, steep towards the sea, and sloping towards the landward side. This chain commences with Table Mountain in the South of Africa, proceeds to Behring's Straits, and thence through America southward to Cape Horn.

It will be seen, on inspecting the map, that the land is very unequally distributed over the surface of the globe—the greater part of it lying to the north of the equator. If you divide the globe into two hemispheres, so that London shall be the centre of one of them, you will perceive that the hemisphere of which that city is the centre contains nearly all the land upon the globe, while the other is almost wholly covered with water.

The land is arranged into two great continents, which are often called the Eastern and Western Continents, or the Old World and the New. In one respect these continents are very different; for while the former is broad and massive, and stretches from north-east to south-west, and chiefly to the north of the equator, the latter, on the contrary, is long and narrow, and extends from north to south, almost from pole to pole. Yet as regards their outlines generally, there is a marked resemblance between them. Towards the north, where they are joined one to the other, both extend into broad flats, while towards the south they gradually separate and narrow down to points lofty and rocky. Thus Asia terminates in the high rocks of Cape Comorin; Africa in the terraced plateaus of the Cape of Good Hope; America in the rocky precipices of Cape Horn; and Australia in the abrupt heights of Cape South-East in Tasmania. Nor is this configuration found only in the chief masses of the continent; it is found also in the limbs or peninsulas which they put forth. All these peninsulas, with the exception of Yucatan and Jutland (which are only plains of alluvial land) contract and point towards the south.

The relative proportions of land and water on the earth's surface are as 3 to 10,—the land occupying only about 51,000,000 square miles, while the water occupies 145,000,000. No one can explain why this particular proportion has been prescribed. But enough is known to prove how unfounded is the notion that there is too much sea. The numerous deserts of the earth bear witness that the earth is not overdone with water, and that, in spite of the vast acreage of the ocean, there are tracts of land which its vapour cannot reach, and certainly cannot drench. When a wind, charged with moisture from the sea, sets out on its travels over a continent, it gradually deposits its freight as it proceeds; and should it encounter a range of high mountains, the cold at their chilly tops extracts the humidity in the shape of snow, leaving the breeze to pursue its course, beggared of the fatness which the soil demands. There are countries where showers rarely fall, because the intervening regions steal all the vapour which the prevailing winds obtain from the ocean exchequer. Peru, for example, is in this predicament; and in the saharas of Asia, Africa, and Australia, Jupiter Pluvius is almost equally unknown. Looking at these barren regions, we may well ask whether the world *could be kept in working* order—whether its rivers and lakes could be sufficiently supplied and its meadows adequately irrigated—if the area of the great nursery of vapour were seriously curtailed. *Compiled.*

SURFACE OF THE LAND.

In some places the land is lower than the level of the sea; in other places only a few inches, in others, again, thousands of feet above that level. Extensive tracts of low-lying land, which are either below the sea-level or only a little higher, go by the name of *Lowland Plains;* and when not dead flats, their surface is usually of a waving or undulating character. These plains are, in the Old World, denominated steppes, heaths, deserts; in the New World, prairies, savannas, pampas.

Elevated plains, which rise abruptly from the general level of the surrounding country, are called *Table-Lands* or *Plateaus*. Sometimes these upland plains are found extended one above another; so that, when viewed from the side, they present the appearance of a series of terraces—of which there is an instance on the southern slope of the mountains at the Cape of Good Hope. The grandest example of a plateau is that of Central Asia, enclosing Chinese Tartary and Tibet: it is several thousand feet above the level of the sea, and is supported by immense ramparts of mountains.

Mountains are the highest prominences on the surface of the globe. They vary greatly in size, in shape, and in height, and also in the manner in which they are arranged relatively to one another. When composed of hard rock, they are usually of great elevation, and have rugged sides and sharp peaks; but when composed of softer rock, they are lower and less steep, and, instead of running up into sharp and jagged peaks, present a rounded, domelike appearance. The slope or declivity of mountains is generally steep on one side, and gentle on the other; and usually the steeper declivity is towards the sea. When a mountain extends horizontally for a considerable distance without interruption, it is called a *ridge;* and when several ridges are connected in one line, they are called *chains* or *ranges.*

The loftiest mountain-range in the world is the *Himalaya* chain, on the borders of Tibet. The highest mountain in this range is stated to be 29,002 feet, or about 5½ miles in perpendicular elevation (1). Next in height to the Himalayas are the Andes, in South America, which extend more than 4000 miles in length, from the province of Quito to the Straits of Magellan. The loftiest summit of the Andes is Aconcagua in Chili, which is said to be 23,910 feet, or 4½ miles, above the level of the sea (2). The highest mountains in Europe are the Alps, which run through Switzerland and the north of Italy. Mount Blanc, the highest in this range, is 15,784 feet (3). The highest mountain in Britain is Ben Nevis, 4406 feet (4).

There are mountains which contain immense perforations (in some cases more than two miles in circumference), reaching from their summits to an immeasurable depth into the bowels of the earth. From these openings are frequently thrown up torrents of fire and smoke, rivers of melted metals, clouds of ashes and cinders, and sometimes redhot stones and rocks, producing the most terrible devastations through all the surrounding districts. These are *Volcanoes* or volcanic mountains; and they are termed *active* or *extinct* according as their eruptions still continue or appear to have permanently ceased. The most noted mountains of this kind in Europe are Mount Hecla, in Iceland; Etna, in Sicily; and Vesuvius, near the city of Naples, in Italy. The number of active volcanoes is estimated at about 270, nearly 190 of which are upon the islands or shores of the Pacific Ocean.

Compiled.

THE ALPS.

WHO first beholds the Alps—that mighty chain
Of mountains, stretching on from east to west,
So massive, yet so shadowy, so ethereal,
As to belong rather to heaven than earth—
But instantly receives into his soul
A sense, a feeling that he loses not,
A something that informs him 'tis a moment
Whence he may date henceforward and for ever?

Great was the tumult there
Deafening the din, when in barbaric pomp
The Carthaginian on his march to ROME
Entered their fastnesses. Trampling the snows,
The war-horse reared; and the towered elephant
Upturned his trunk into the murky sky,
Then tumbled headlong, swallowed up and lost,
He and his rider.—Now the scene is changed;
And o'er Mount Cenis, o'er the Simplon winds
A path of pleasure. Like a silver zone
Flung about carelessly, it shines afar,
Catching the eye in many a broken link,
In many a turn and traverse as it glides;
And oft above and oft below appears,
Seen o'er the wall by him who journeys up,
As though it were another, not the same,
Leading along he knows not whence or whither,
Through glens locked up before.

Not such *my* path!
Mine but for those, who, like Jean Jacques, delight
In dizziness, gazing and shuddering on
Till fascination comes and the brain turns!
Mine, though I judge but from my ague-fits,
Over the Drance, just where the Abbot fell,
The same as Hannibal's.—But now 'tis past,
That turbulent Chaos; and the promised land
Lies at my feet in all its loveliness!
To him who starts up from a terrible dream,
And lo, the sun is shining, and the lark
Singing aloud for joy,—to him is not
*Such sudden ravish*ment as now I feel
*At the first glimps*es of fair ITALY.

ROGERS.

TERMS USED IN INDUSTRIAL SCIENCE.

THE first thing the student of Industrial Science has to do, is to make himself acquainted with the terms of the science, and the precise acceptation in which they are used; and happily a knowledge of their meaning carries with it a simultaneous knowledge of the leading facts and principles of the science. These terms are chiefly the following—*Wealth*, *capital*, *profit*, *value*, *price*, *wages*, *supply and demand.*

Wealth.—Of the manifold things which sustain and adorn existence, only a small portion is obtainable without labour. The earth we tread upon, the air we breathe, the water we drink, are, it is true, no products of human labour; nor does man's labour, so far as we see, increase these things; for though man is said to produce, it is beyond his power to create. But in order that these and the other bounties of nature may yield what is necessary for the sustenance and embellishment of life, there must be labour or industry. Before wheat can be raised from the soil, there must be labour; and before bread can be made from wheat, there must be further labour. Without labour, cotton cannot be converted into calico, nor flax into linen, nor sheep's skin into leather. It is only as the result of industry that the various minerals assume the form of bricks and tiles, glass and crockery, tools and utensils. There must be much and various labour before the coal can be dug out of the earth, to warm our houses, to cook our food, and, through the medium of gas-works and iron pipes, to furnish us with artificial light.

In our common speech the term *wealth* is applied to whatever we possess in abundance, whether the possession be the free gift of nature or the produce of labour. But in Industrial Science the term is restricted to those things which are the produce of labour. The individual articles of which wealth consists—as farms, cattle, mines, machinery, canals, *railways*, *money*—have, of course, individual names attached to them; and they have also general names, such as *goods*, *commodities*, and the like. But the collective name given to them is *wealth*. Whatever is the produce of labour, is, in Industrial Science, denominated *wealth*.

Capital.—Most wealth-possessors use their wealth for two purposes. A manufacturer, for example, whose wealth consists, on the one hand, of a house, a garden, carriages, books, pictures; and, on the other hand, of a factory, with machinery and a stock of raw cotton or flax, does not use both these portions of his wealth for the same end. He uses his house, garden, carriages, etc., for the gratification of his pleasure or taste; but his factory, machinery, and raw material he uses in order to get more wealth. In like manner, a monied man—that is, a man whose wealth consists wholly or chiefly of money—employs part of it for his own maintenance or enjoyment, and lends the remainder to people who pay him for the loan of it—his object in thus lending it for a stipulated payment being to increase his wealth.

That part of wealth which is used for the purpose of increasing wealth, is called *capital*. And as there are many kinds of wealth, so there are also many kinds of capital. Thus, seeds, cattle, manure, and implements are the farmer's capital; warehouses, ships, and goods for sale are the merchant's capital; while land and houses are the landlord's capital. Professional capacity acquired by study and practice forms the capital of the physician and the lawyer. The workingman's capital is his strength, skill, and tools.

Nearly all capital is used in three ways—viz., in producing raw material, as in the case of farming, gardening, cotton-growing; in changing the form of raw material, as in the case of turning wheat into bread, cotton into calico, hides into leather; and in conveying commodities from one place to another, as in the case of shipping, railways, and other methods of transport.

Profit.—It is with a view to its increase that a man employs his capital in trade or commerce; and the increase which accrues from so employing it is denominated *profit*.

Let us suppose that a man, who possesses only three shillings, becomes a street-hawker. He buys two shillings' worth of fruit to sell again, and with the remaining shilling a basket to carry his fruit in. His capital is now his fruit and basket. He sells his fruit for three shillings, and thereby gains one shilling. In other words, by using his capital, he increases it from three to four shillings, and thus makes one shilling of *profit.* To whatever is gained by the use of capital we apply the name *profit*, except when capital is lent out for a stipulated payment—in which case the gain is called *interest.*

Although profit and interest are only different forms of gain from the use of capital, yet it deserves remark that the former always is, or ought to be, larger than the latter. When a man lends his capital, he does so with the belief that the person to whom he lends it, is sure not only to pay the stipulated interest, but also to return the capital when wanted: and usually he exacts from the borrower securities or guarantees sufficient to warrant such belief. All, then, that he is entitled to from the borrower is a fair payment or interest for the use of his capital. But when, instead of lending out his capital to be employed in business by another person, he enters into business with it himself, he ceases to be sure of any fixed gain—he runs the risk of lessening it, and even losing it, while he is, moreover, put to the trouble of laying it out and managing it in his business. In this latter case, he is obviously entitled to a larger return than in the former case. For he requires not only a fair payment for the use of his capital, but also a payment for the risk he runs, and a further payment for his trouble in managing his business.

Value.—A boy with a shilling can get many things in exchange for it; he can get a knife, or a book, or two sixpences, or twelve pennies. In each case he would get the worth or *value* of his shilling; for, in the language of Industrial Science, the *value* of a thing is just what can be got in exchange for it. If a boy can exchange his ball *for another boy's top*, the top is the *value* of the ball; if a workman can obtain a sovereign for his week's work, the sovereign is the *value* of his work. Everything that can be exchanged for anything else is said to have *value*. And as the value of a thing is just what is obtainable in exchange for it, the more anything will exchange for, the greater is its value.

Few commodities, if any, have the same value at all times. At one time the baker may get in exchange for his loaf nearly twice as much as at another time. This year the workman may obtain a sovereign for his week's work, and next year only fifteen shillings. A log of timber which six months ago was worth only £5, may fetch double that sum to-day. The only thing which does not materially fluctuate in value is gold;—a fact which accounts for the employment of gold as a measure or standard of value.

Price.—By *price* is meant the value of any commodity measured in money. We say, for example, that a house is worth so many pounds, shillings, and pence. This sum of money we call the *price* of the house; so that the price of a thing is just its money-value, or what it will fetch in money. It need scarcely be said, that when commodities fluctuate in value, their price must also fluctuate. Indeed, it is through fluctuations in price, that we are led to notice and measure fluctuations in value.

Wages.—*Wages* is the name given to the price of labour, or the payment for labour. There are, indeed, other names. Thus, when the payment is made by the year, it is often called a salary or stipend; when made on account of a given amount of labour, it is called a fee. It is only when it is paid by the day or the week or the month, that it is always called *wages*. Clergymen, teachers, and clerks usually receive salaries or stipends; physicians and lawyers receive fees; smiths, masons, carpenters, printers, and other workingmen, receive wages. But, no matter by what name payment for labour is called, such payment is always the *price of labour; and that* price, like the price of every other commodity, *is subject to* fluctuation.

Supply and Demand.—By *supply* is meant the quantity of commodities for sale; and by *demand*, the quantity of commodities wanted by purchasers. However abundant the commodities in any country, they are not called a *supply*, until they are for sale, or in the market; nor do we consider a *demand* for them to exist, however strong and general the desire to possess them, until purchasers appear who have money or other commodities to offer in exchange. A desire to obtain may exist on the part of those who have not the means of buying; but a desire felt by persons so circumstanced does not constitute what is called *demand*. *Demand* implies both the desire to obtain and the means of buying. When there are more goods in the market than can be disposed of, we say that the supply is greater than the demand; and when, again, there are not sufficient goods to serve all the purchasers, we say that the demand is greater than the supply. *Compiled from* TEMPLAR *and* DAWES.

SPECIMENS OF DESCRIPTIVE TRAVEL.

The Pyramid of Gizeh.—WITH what amazment did we survey the vast surface that was presented to us when we arrived at this artificial mountain, which seemed to reach the clouds! Here and there appeared some Arab guides upon the immense masses above us, like so many pigmies, waiting to show the way to the summit. The mode of ascent has been frequently described. The reader may imagine himself to be upon a staircase, every step of which, to a man of middle stature, is nearly breast high; and the breadth of each step is equal to its height; consequently the footing is secure; and although a retrospect, in going up, be sometimes fearful to persons unaccustomed to look down from any considerable elevation, yet there is little danger of falling. In some places, indeed, where the stones are decayed, caution may be required; and an Arab guide is always necessary to avoid a total interruption; but, upon the whole, the means of ascent are such that almost every *one may accomplish* it. Our progress was impeded by other causes. We carried with us a few instruments, such as our boat-compass, a thermometer, a telescope; these could not be trusted in the hands of the Arabs, and they were liable to be broken every instant. At length we reached the topmost tier, to the great delight and satisfaction of all the party. Here we found a platform, thirty-two feet square, consisting of nine large stones, each of which might weigh about a ton; although they be much inferior in size to some of the stones used in the construction of this pyramid. Travellers of all ages, and of various nations, have here inscribed their names. Some are written in Greek, many in French, a few in Arabic, one or two in English, and others in Latin. We were as desirous as our predecessors to leave a memorial of our arrival; it seemed to be a tribute of thankfulness due for the success of our undertaking; and presently every one of our party was seen busied in adding the inscription of his name. DR E. D. CLARKE.

The Nile.—THE Nile is all in all to the Egyptian. If it withheld its waters for a week, his country would become a desert. It waters and manures his fields, supplies his harvest, and then carries off their produce to the sea for exportation. He drinks of it, he fishes in it, he travels on it: it is his slave, and used to be his god. The inundation of the Nile begins in May, and attains its full height in August. Then it is that Egypt presents one of the most striking of its Protean aspects, becoming one archipelago, studded with green islands. Every island is crowned with a village, or an antique temple, and shadowy with palm-trees or acacia-groves. Every city becomes a Venice, and the bazaars display their finest cloths and tapestries to the illuminations that are reflected from the streaming streets. The earth is sheltered from the burning sun under the cool bright veil of waters; the labour of the husbandman is suspended, and it is the season of universal festivity. Boatmen alone are busy; *but it would seem to* be pleasant business, for the sound of *music is never silent* beneath those large white wing-like sails. As the waters retire, vegetation seems to exude from every pore. Previous to its bath, the country, like Pelias, looked shrivelled, and faded, and worn out; a few days after it, old Egypt looks as good as new, wrapped in a richly green mantle, embroidered with flowers. Great part of this picture, however, is now of rare occurrence, the inundation seldom rising to a height greater than what is necessary for purposes of irrigation, and presenting, alas! rather the appearance of a swamp than of an archipelago.

WARBURTON.

Pompeii.—THE reader will bear in remembrance that only sixteen years elapsed between the overthrow of the greater part of Pompeii by an earthquake in A.D. 63, and its final destruction in A.D. 79. This brief interval had been diligently employed by the citizens in rebuilding the ruined town, and hence it was fresh from the hands of the artists and workmen, when the sudden outbreak of Vesuvius buried it in the grave where it lay undisturbed for nearly seventeen centuries. This accounts for the abundant traces of half-finished work which everywhere meet our view. We see temples in the progress of erection, with the columns half-hewn, the walls just rising, and the masons' tools lying beside them; and the whole looks so fresh and new, that you would almost suppose the mason was only gone to his dinner, and about to come back to resume his work. What a scene altogether is Pompeii! The mind receives here the astonishing impression of a nation risen from the dead, their daily life actually passing before our eyes. They are before us who were suddenly stopped by the hand of death in the midst of their labours and pleasures, surrounded by all the circumstances of their diurnal occupations. The storm came, but swept them not away from the face of the earth like other men, who depart and are seen no more; here seventeen hundred years elapse, and all are brought to light again, with their habitations, their temples, their arms, and their implements. Like a watch that has stopped in the night, but still points to the hour when it ceased to vibrate, this city is found fixed by the hand of death in all the varied attitudes of busy movement; skeletons at dinner, surrounded by the fragments of their feast; skeletons counting that gold which mocks at the corruption of its owners; skeleton judges and skeleton prisoners in the forum; skeleton philosophers lecturing their skeleton disciples in the halls; and skeleton lovers still prostrate at the feet of their skeleton mistresses. Wonderfully curious, the whole scene is a bitter satire on human vanity. *Anonymous.*

The Pampas.—THE great plain, or Pampas, on the east of the Cordillera, is about 900 miles in breadth, and divided into regions of different climate and produce. On leaving Buenos Ayres, the first of these regions is covered for 180 miles with clover and thistles; the second region, which extends for 450 miles, produces long grass; and the third region, which reaches the base of the Cordillera, is a grove of low trees and shrubs. The second and third of these regions have nearly the same appearance throughout the year, for the trees and shrubs are evergreens, and the immense plain of grass only changes its colour from green to brown; but the first region varies with the four seasons of the year in a most extraordinary manner. In winter the leaves of the thistles are large and luxuriant, and the whole surface of the country has the rough appearance of a turnip-field. The clover in this season is extremely rich and strong; and the sight of the wild cattle grazing in full liberty on such pasture is very beautiful. In spring the clover has vanished, the leaves of the thistle have extended along the ground, and the country still looks like a rough crop of turnips. In less than a month the change is most extraordinary: the whole region becomes a luxuriant wood of enormous thistles, which have suddenly shot up to a height of 10 or 11 feet, and are all in full bloom. The road or path is hemmed in on both sides; the view is completely obstructed; not an animal is to be seen; and the stems of the thistles are so close to each other, and so *strong, that, independent* of the prickles with which they are armed, they form an impenetrable barrier. The sudden growth of these plants is quite astonishing; and though it would be an unusual misfortune in military history, yet it is really possible that an invading army, unacquainted with the country, might be imprisoned by these thistles before it had time to escape from them. The summer is not over before the scene undergoes another rapid change: the thistles suddenly lose their sap and verdure, their heads droop, the leaves shrink and fade, the stems become black and dead, and they remain rattling with the breeze one against another, until the violence of the hurricane levels them with the ground, where they rapidly decompose and disappear; then the clover rushes up, and the scene is again verdant. SIR F. HEAD.

TO AN EGYPTIAN MUMMY.

AND thou hast walked about (how strange a story!)
In Thebes's streets three thousand years ago,
When the Memnonium was in all its glory,
And time had not begun to overthrow
Those temples, palaces, and piles stupendous,
Of which the very ruins are tremendous.

Speak! for thou long enough hast acted Dummy,
Thou hast a tongue—come let us hear its tune;
Thou 'rt standing on thy legs above ground, Mummy!
Revisiting the glimpses of the moon,
Not like thin ghosts or disembodied creatures,
But with thy bones and flesh, and limbs and features.

Tell us—for doubtless thou canst recollect—
To whom should we assign the Sphinx's fame?
Was Cheops or Cephrenes architect
Of either pyramid that bears his name?
Is Pompey's Pillar really a misnomer?
Had Thebes a hundred gates, as sung by Homer?

Perchance that very hand, now pinioned flat,
Has hob-a-nobbed with Pharaoh glass to glass;
Or dropped a halfpenny in Homer's hat,
Or doffed thine own to let Queen Dido pass

Or held, by Solomon's own invitation,
A torch at the great Temple's dedication.

Since first thy form was in this box extended,
We have, above ground, seen some strange mutations;
The Roman empire has begun and ended,
New worlds have risen—we have lost old nations;
And countless kings have into dust been humbled,
While not a fragment of thy flesh has crumbled.

Didst thou not hear the pother o'er thy head
When the great Persian conqueror, Cambyses,
Marched armies o'er thy tomb with thundering tread,
O'erthrew Osiris, Orus, Apis, Isis,
And shook the Pyramids with fear and wonder,
When the gigantic Memnon fell asunder?

If the tomb's secrets may not be confessed,
The nature of thy private life unfold:—
A heart has throbbed beneath that leathern breast,
And tears adown that dusky cheek have rolled:—
Have children climbed those knees and kissed that face?
What was thy name and station, age and race?

Statue of flesh—immortal of the dead!
Imperishable type of evanescence!
Posthumous man, who quitt'st thy narrow bed,
And standest undecayed within our presence,
Thou wilt hear nothing till the Judgment-morning,
When the great trump shall thrill thee with its warning.

Why should this worthless tegument endure,
If its undying guest be lost for ever?
O let us keep the soul embalmed and pure
In living virtue, that, when both must sever,
Although corruption may our frame consume,
The immortal spirit in the skies may bloom!

HORACE SMITH.

PARDON OF SIN, THE FREE GIFT OF GOD.

IN the Holy Scriptures we find two doctrines respecting the *pardon* of sin, which, at first sight, appear contradictory. *We are taught, on the* one hand, that pardon is gratuitously bestowed by God; and, on the other hand, that it has been purchased at the cost of the precious blood of Christ. How are these two doctrines to be reconciled? Can pardon be a free gift on the part of God, when He has actually received a price for it?

A brief consideration of the case will show us that the gratuitousness of pardon is not really lessened, but rather enhanced, by the ransom which has been exacted and paid.

With *whom* did the plan of redemption originate? Did it originate independently of God, or against His will? Had Christ, the sinner's Surety, to go and placate a God previously relentless? On the contrary, it was God Himself who spontaneously said,—"Deliver from going down to the pit—I have found a ransom." It was God Himself who "so loved the world that he *gave* His only-begotten Son." The ransom paid by Christ, so far from being the procuring cause of God's grace to sinners, was itself the effect of that grace.

God, it should be remembered, stands in a twofold relation to us. He is at once our Sovereign and our Father. Now, it is quite conceivable that, though as a just Sovereign He could not suffer our offences to pass unpunished, nor absolve us from them, except on the ground of an adequate satisfaction, yet, as a loving Father, He might pity our hapless case, and even provide the means of satisfaction. This is conceivable—nay, this is the actual fact. You recollect how King David felt and acted when Absalom violated his duty as a son and a subject. As a king, David could not honourably remit the penalty due to Absalom's rebellion. But as a father he longed to restore the infatuated youth to his forfeited rank. With all his heart he wished for some mediator at whose instance he might give effect to his paternal love without compromising the honour of his government; and so, when, at the instigation of Joab, the widow of Tekoah came to the royal court, and interceded in behalf of Absalom, the fond father was ready—yea, eager—to admit her mediation, and give effect to it. Now, just as Absalom's restoration was thus due *ultimately*, not to the intercession of the widow of Tekoah, but to the paternal love of David, so is our pardon due *ultimately*, not to the ransom paid for us by Christ, but to the free self-moved love of our Heavenly Father. As a righteous Sovereign, God must execute justice and judgment; but, from His benignity as a Father, He is inclined to exercise mercy. And it was to the very end He might be able to bestow mercy without any infraction of law and justice that He sent his Son into the world to suffer and die in the room of sinners.

Nor does it derogate from this spontaneous love of God that He laid on Christ the work of making atonement. If, indeed, Christ had been a Being less closely connected with God than He really is, then God's love in providing redemption might have been sullied by His severity to Christ; and it might have been plausibly alleged that His kindness to us was at the expense of injustice to our Surety. But when we remember that Christ is one with God—yea, God himself, we must perceive that the exactor of the price and the payer of the price were both one, and that the exaction and the payment were alike the result of love. It said much for David's paternal love that he longed to recall his son from exile, and was eager to admit any mediation in his behalf. But how much more would it have said for David's love had he, in order to the removal of every bar to his son's recall, descended from his throne, and submitted in his own person to the penalty of rebellion in Absalom's stead! Yet this, and nothing short of this, is what the most High God has done in order to the redemption of us His rebellious children. He has Himself paid our heavy debt, that He might be able to bid us go free.

HOLINESS AS NECESSARY TO SALVATION AS PARDON.

PARDON of sin is not all that we need in order to salvation. Could we suppose a sinner to be pardoned and restored to the Divine favour, while no change was effected on his *character, he* could derive scarcely any benefit from his *pardon, because he* could have no relish for the service of

God. Were he even admitted into heaven, its holy society and its spiritual service would to him be intolerable; for happiness does not result from situation, but from an agreement between faculties and objects, desires and enjoyments.

If a prisoner under sentence of death for murder or some other capital crime, were, while in prison, to be seized with the jail-fever to such a degree as to ensure his death by the disease, independently of a public execution according to his sentence, and if in this state he were to receive a pardon from his prince, of what use would it be to him? His prison-doors are set open; but the diseased man cannot leave prison; his life is spared by his prince, but it falls a victim to his malady. It is only on the supposition that his prince, at the time he pardoned, could also rebuke the malady, and restore health, that the pardon could be of any real benefit. Now, as sinners our case is precisely parallel to this. We are under a judicial sentence of condemnation; but we are at the same time under the power of the disease of sin. We are depraved in heart, alienated from God, and utterly averse from the holy and spiritual blessings and enjoyments of His family. Though we cannot but seek happiness, we naturally seek it not in God, but in the creature. The thought of immediate fellowship with God rather pains than attracts us; and a life beyond the grave, in a state of separation from the objects of sense, we regard as the ruin of our happiness rather than its perfection.

If, then, we are not delivered from this moral malady, of what use could forgiveness be to us? We should still be miserable: for sin and wretchedness are inseparable, being in the very nature of things connected together by a law as steady and invariable as that which regulates the planets. The misery consequent upon sin does not arise from the arbitrary frown of Heaven, or from the positive infliction of superior power. When the divine law denounces the infliction of punishment, it declares what will, in the very nature of things, be the effect of sin to the *transgressor,—it adds its* sanction to the constitution of nature.

Heaven and hell are, so to say, the names of opposite characters; the former of which is connected with happy consequences, and the latter with all that is wretched. Till spiritual health, therefore, is restored, or, in other words, till we are conformed to the character of God, we cannot be happy. Even the Almighty, with reverence be it said, cannot otherwise make us happy. RUSSELL.

LAWS OF MOTION.

OWING to that property of matter which we call *inertia*, no body at rest can put itself in motion. Before any body can change its place, it must be acted on either by another body already in motion, or by one or other of those natural forces which, in mechanics, are denominated *prime movers.* There are many such forces. There is, for example, the *muscular strength* of man and other animals; as we daily witness in the case of boys throwing stones, and of horses drawing waggons. There is the force of *gravity*, which, for instance, causes stones to fall to the ground. There is *wind*, which drives our ships across the sea. *Water*, too, supplies a motive power; so does the expansive force of *steam*; and there are various other mechanical agents which nature has endued with like power.

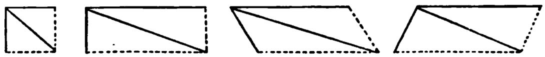
When a body is put in motion, it moves in the direction of the force impressed upon it, and at a rate answerable to the strength of that force. Thus, a billiard ball takes the direction given to it by the cue, and moves fast or slow according to the force of the stroke. The rate at which a body moves is termed its *velocity;* and velocity is said to be *uniform*, *retarded*, or *accelerated*, according as the motion is constant, decreasing, or increasing.

A moving body possesses impetus or *momentum;* and this momentum, which is just the product of its combined *weight and* velocity, may be increased by increasing either *the weight or th*e velocity of the body. A light ball of lead dropped upon a man's foot, from a height of a few yards, will not hurt him, but a heavy ball dropped from the same height will bruise his foot. A bullet thrown by the hand against a thin board will make only a slight impression, but a similar bullet discharged from a rifle will pass through the board.

When a body in motion strikes a body at rest, it meets with a resistance equal to the blow struck. The body at rest reacts upon the body in motion with exactly the same force as the latter acts upon the former. Thus, when a ball is thrown against a wall, it rebounds, owing to the reaction of the wall. Birds, in flying, strike the air with their wings, and it is the reaction of the air upon their wings which enables them to rise.

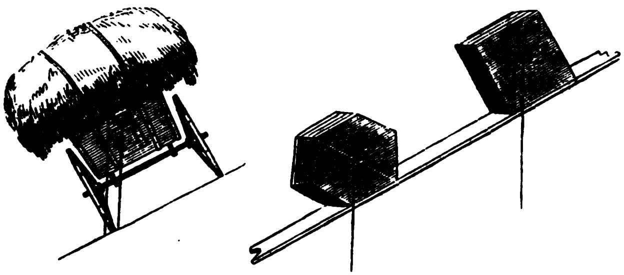
When two or more forces are applied to a body simultaneously, the result is the same as if each of them acted on the body separately. If two forces, for example, act in the same direction, the impetus given to the body will be the *sum* of their united action. If, on the other hand, they act in opposite directions, the one will counteract, according to the measure of its power, the efforts of the other, and the result will be an impetus equal to the *difference* between the two forces, and in the direction given by the stronger. Let two boys in a boat pull in the same direction, the speed of the boat will be the *sum* of what each of them could produce separately; but if the one boy pulls one way, and the other an opposite way, the speed of the boat will only amount to the *difference* between the two pulls, and will be in the direction given by the stronger of the two. If the pulls are of equal strength, no motion will take place, for forces which are equal and opposite destroy each other.

When two forces, instead of acting in the same line of direction, are applied in directions inclined to each other, the body acted on moves in a line between the two. Thus, if a piece of wood be thrown into a river, when the wind blows right across, it will be carried to the other side, but lower down. If the two forces are inclined to each other at an angle of 90°, the body will move in the diagonal of a *square or rectangle*; if they are inclined at any other angle, whether acute or obtuse, it will describe the diagonal of a parallelogram.



If a body is acted on by two forces, by one of which it is projected forward in a right line, while by the other it is continually directed towards a fixed point, the result will be a *circular* motion. For instance, when you whirl a ball which is fastened to your hand by a string, its circular motion is due to two forces—the force which you give it in projecting it forward, and the force of the string which fastens it to your hand; if, during the motion, the string were to break, the ball would fly off in a straight line; because it would then be acted upon only by the force of projection. The force which confines or draws a body to a centre is called the *centripetal* force; and the force which impels it to fly off is called the *centrifugal* force. The planets are kept in their orbits by the action of two such forces—the one drawing them towards the sun, the other impelling them to fly off at a tangent; the consequence is—both forces being constant—that they revolve in orbits nearly circular. It is only, however, when these two forces balance each other, that the motion is circular. If one of the forces produces a uniform, and the other an accelerated motion, the body will move in another curve than a circle. Thus, when a stone is thrown from the hand in a horizontal direction, it is acted upon by two forces—the force of projection given to it by the hand, and the force of gravity which finally brings it to the ground; but as the motion produced by the projecting force alone is uniform, while that produced by the constantly increasing force of gravity is accelerated, the stone is made to describe a curve, which, but for the resistance of the air, would be a *parabola.*

Although bodies differ widely in size and in shape as well as in weight, yet there is in each of them one special point where the motive force may be more effectually applied than at any other. This is called the *centre of gravity*, and it is the point around which all the parts of a body are so equally balanced that the whole body will move, if *it* is moved, and remain at rest, if *it* is supported. A straight line falling perpendicular from the centre of gravity, is called the *line of direction;* and only when that line falls within its base will a body stand firm. The narrower the base upon which a body rests, the more readily is it upset; but there is difficulty in overturning a body with a broad base. Thus, a cask is easily rolled along, while a square box is moved with difficulty. When a man, in wrestling, is likely to be thrown down, he puts his feet as far asunder as possible. When a rope-dancer finds himself in danger of losing his balance, he shifts the heavy pole which he holds in his hand, so as to change the situation of the centre of gravity. The higher, too, the centre of gravity, the more easily is a body overturned. A coach, empty inside, with passengers and luggage outside, is in more danger than if there were people inside. A boat is in greater danger of being upset, if the passengers rise up suddenly, than if they keep their seats. In man the centre of gravity is so situated that the line of direction falls between his feet when standing; and it is the same in the case of quadrupeds. A dog cannot long stand on his hind legs, because the centre of gravity is too far forward. Ducks, geese, and swans walk awkwardly for a similar reason. In cats and other animals, which spring upon their prey, the centre of gravity is so situated that they *uniformly fall on their* feet.



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MACHINERY AND ITS USES.

INSTRUMENTS contrived for the purpose of applying and regulating moving power receive various names according to the degree of their complexity. Thus, an instrument of simple construction, designed to assist the human hand—such as a spade or a saw—is called a *tool.* An instrument composed of two or more tools which act on each other, is called a *machine;* while a machine of considerable magnitude, or of more than usual nicety of construction, is termed an *engine.* Thus we speak of a reaping-machine, and of a steam-engine. In many cases, however, the line of demarcation between tools and machines and between machines and engines, cannot be easily drawn. And it is, therefore, fortunate that we have a term—*Machinery*—which comprehends them all.

Machinery has no power of motion in itself. Before it can either itself move or give motion to the body to which it is applied, it must have power communicated to it by some external force. It must be itself acted on before it can act on anything else. It is simply a passive instrument interposed between the motive force and the body to be moved; and all that it can do is to receive and deliver the impulse which has been impressed upon it. A spade cannot dig without the hand of the labourer; a mill-wheel cannot turn round without the falling water; a steam-engine cannot propel the paddle-wheel, until the expansive force of steam is brought to act on the piston.

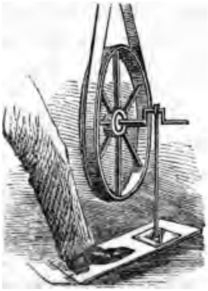
Yet, though machinery cannot create force, it enables us to apply, in the most efficient manner, those natural forces which are at our command; and, when properly constructed and applied, it gives us power to turn those forces to many valuable uses. As a sample of these uses, it may suffice to refer to a few of the ways in which machinery aids muscular power.

In building operations, it is often necessary to raise heavy bodies—for instance, blocks of sandstone or of granite—to a considerable height. In all such cases muscular strength would avail little without the help of machinery. If the size of the block is small compared with its weight, it will not present a surface large enough to allow a sufficient number of men to take hold of it; and even should it admit of being laid hold of by a sufficient number of men, they will not be able to raise it higher than their own arms can reach. But by the intervention of a rope and pulley, any number of men may combine their efforts, and raise the block to almost any height they please.

Machinery affords us similar aid in overcoming friction and other impediments to motion. No one could drag a heavy block of stone along a rough road; but by placing wheels or rollers under it, the friction is so diminished that the stone is easily moved. In like manner, the inclined plane lessens the opposition of gravity to our efforts in lifting. "A gradually ascending mound of earth," it has been said, "would have enabled our British ancestors to draw up to its place the heaviest block at Stonehenge."

What a help, again, is machinery in operations requiring great exactness and nicety of execution! The most skilful workman is unable, even with the aid of tools, to make a bar of iron so perfectly round that no inequalities shall be found in it; but in a lathe a rod perfectly round can be turned without difficulty. No two hand-made articles are ever, in all respects, exactly alike; but by means of a mould thousands of articles may be formed so perfectly similar, as to be indistinguishable one from another.

Does not machinery, also, enable us to regulate motion—to increase, or diminish, or equalize its velocity at our pleasure? The human hand can move a body, and so can the foot, but not very rapidly, and both hand and foot soon become fatigued by the operation. But by means of a *multiplying wheel* or a *treadle*, a rapid movement can be produced and long kept up, with but little fatigue to hand or *foot.*



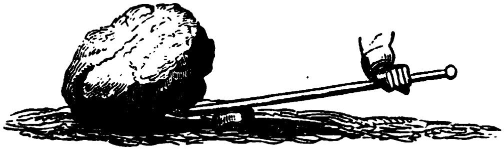
No human hand could, for any length of time, make a body move regularly backwards and forwards; but in a clock the pendulum swings steadily day and night, performing its oscillations with invariable regularity, and marking for us the progress of the hours. And—to name but one other instance—think of the way in which a reserve of motive force is laid up in a watch, and given regularly off as it is required! So happily constructed and nicely attached to the other parts of the watch is the *spring*, that a few seconds expended in turning the key keeps the machinery going for twenty-four hours, without any further interference on our part.

In these and manifold other ways does machinery assist human power. But muscular strength is only one of the forces which is made available by the intervention of machinery. The wind, the running stream, the expansive force of steam, and other giant forces of nature are similarly made our servants; and through them we acquire powers of labour and production, far greater than all human strength combined could supply. *Compiled.*

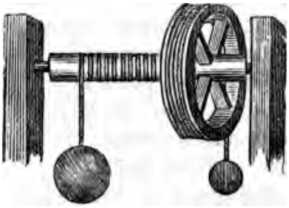
THE MECHANICAL POWERS.

EVERY machine or engine, however complicated, will be found, on examination, to be made up of two or more simple machines combined together. These simple machines, which are called the *mechanical powers*, are six in number, and have the following names,—the Lever, the Wheel and Axle, the Pulley, the Inclined Plane, the Wedge, and the Screw.

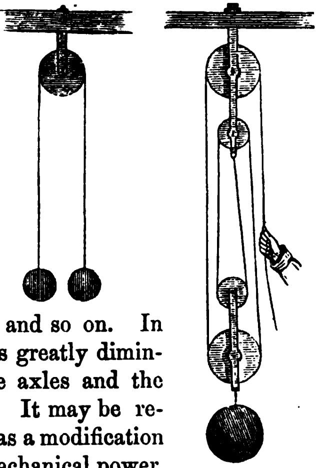
Every one has seen men raising a stone by means of a bar of iron. This bar is a *Lever*. In this machine three things are to be considered,—the power or force which presses on it, the weight to be raised, and the prop on which



it rests. The advantage gained results from having the power which presses much farther from the prop than the weight to be raised. If the distance of the power from the prop be four times as great as the distance of the weight, the advantage will be as 4 to 1. If the distance be six times as great, the advantage will be as 6 to 1; and, generally, the power bears to the weight an inverse ratio to the arms of the lever. Levers are of three kinds:—First, when the prop is between the weight and the power;—Second, when the weight is between the prop and the power;—Third, when the power is between the weight and the prop. It is by a lever of the *first* kind that a seaman moves his rudder and a blacksmith his bellows. Gates and doors are levers of the *second* kind—the hinge being the prop on which they move. A spade and a pitchfork for raising hay are instances of levers of the *third* kind.



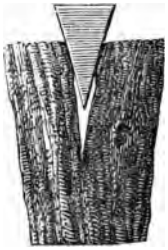
In the *Wheel and Axle*, a weight is raised by means of a rope coiling round the axle, while the power is applied to the outer rim of the wheel. The advantage gained is in proportion to the extent by which the width or diameter of the wheel exceeds that of the axle. The semi-diameter of the wheel, and the semi-diameter of the axle, may be considered as levers of which the centre is the common prop. An equilibrium will be produced when the power is to the weight as the semi-diameter of the axle is to the semi-diameter of the wheel, or as the circumference of the axle is to the circumference of the wheel. In raising weights with this machine the rope coils round the axle and enlarges the diameter; hence the advantage of the power is continually diminishing; and, accordingly, in raising a bucket from a deep well the weight is felt much more sensibly as it approaches the top. We have examples of the wheel and axle in the crane used on wharfs and quays for drawing *goods up from a ship*, and in the capstan for lifting the anchor.



The *Pulley* is used principally in hoisting the sails of ships. A single pulley gives no mechanical advantage, but it is of use in altering the direction in which a force may be applied. If two pulleys be used, the power will keep in equilibrio a weight double its own; if three be used, the power will balance three times as much, and so on. In this machine the advantage is greatly diminished by the friction of the axles and the want of pliancy in the ropes. It may be regarded, as to principle, either as a modification of the lever, or as a distinct mechanical power.

The *Inclined Plane* is used to facilitate the raising of great weights. It is evidently much easier to roll a cask along a plank into a waggon than to raise it from the ground. In the inclined plane, an equilibrium is produced when the power is to the weight as the height of the plane is to the length of its sloping side; but as the friction in the use of this machine is very great, a much less power than that deduced by calculation will keep a body in equilibrio, and a much greater power will be requisite to draw it upwards.

In the *Wedge* the law of equilibrium is, that the power should be to the weight as half the length of the back is to the length of one of the sides; but, on account of friction and other causes, no law can be stated as universally accurate. In real practice, all that we can say is, that the *less the breadth of the* back in proportion *to the length of the* side, the greater is the advantage.



Nature, whose works uniformly display the utmost wisdom in their design, has formed the beaks of birds wedge-shaped, for the purpose of enabling them to dig into the ground, etc. The figure of a bird, too, is similarly fitted for cleaving the air, as is the breastbone of a waterfowl for making way through the water; and the shape of boats and ships may, perhaps, have been first suggested by the shape of these animals. A grand military evolution of the ancients was forming a battalion into the shape of a wedge; and many instances occur in history of an enemy's line having been broken by this contrivance.

The principle of the *Screw* is the same as that of the inclined plane. The weight, instead of proceeding straight forward, moves in a spiral direction, gradually ascending to the top; and the equilibrium is calculated in the same manner as in the inclined plane. *Compiled.*

QUOTATIONS FROM BYRON.

Greece.

He who hath bent him o'er the dead
Ere the first day of death is fled,
(Before Decay's effacing fingers
Have swept the lines where beauty lingers),
And marked the mild angelic air,
The rapture of repose that's there,—
He still might doubt the tyrant's power;
So fair, so calm, so softly sealed,
The first, last look by death revealed!
Such is the aspect of this shore;
'Tis Greece, but living Greece no more!
So coldly sweet, so deadly fair,
We start, for soul is wanting there.

Clime of the unforgotten brave!
Whose land from plain to mountain-cave
Was Freedom's home or Glory's grave!
Shrine of the mighty! can it be,
That this is all remains of thee?
Approach, thou craven crouching slave:
  Say, is not this Thermopylæ?

These waters blue that round you lave,—
Oh servile offspring of the free,
Pronounce what sea, what shore is this?
The gulf, the rock of Salamis!
These scenes—their story not unknown—
Arise, and make again your own;
Snatch from the ashes of your sires
The embers of their former fires;
And he who in the strife expires
Will add to theirs a name of fear,
That Tyranny shall quake to hear,
And leave his sons a hope, a fame,
They, too, will rather die than shame:
For Freedom's battle once begun,
Bequeathed by bleeding Sire to Son,
Though baffled oft is ever won.

Rome.

THE Niobe of nations! there she stands,
Childless and crownless, in her voiceless woe;
An empty urn within her withered hands,
Whose holy dust was scattered long ago;
The Scipios' tomb contains no ashes now;
The very sepulchres lie tenantless
Of their heroic dwellers: dost thou flow,
Old Tiber! through a marble wilderness?
Rise, with thy yellow waves, and mantle her distress.

Thunder-Storm among the Alps.

THE sky is changed!—and such a change! Oh night,
And storm, and darkness, ye are wondrous strong,
Yet lovely in your strength, as is the light
Of a dark eye in woman! Far along,
From peak to peak, the rattling crags among
Leaps the live thunder! Not from one lone cloud,
But every mountain now hath found a tongue,
And Jura answers, through her misty shroud,
Back to the joyous Alps, who call to her aloud!

And this is in the night:—Most glorious night!
Thou wert not sent for slumber! let me be

A sharer in thy fierce and far delight,—
A portion of the tempest and of thee!
How the lit lake shines, a phosphoric sea,
And the big rain comes dancing to the earth!
And now again 'tis black—and now, the glee
Of the loud hills shakes with its mountain-mirth,
As if they did rejoice o'er a young earthquake's birth.

A Ship Foundering.

THEN rose from sea to sky the wild farewell,—
Then shrieked the timid, and stood still the brave,—
Then some leaped overboard with dreadful yell,
As eager to anticipate their grave;
And the sea yawned around her like a hell,
And down she sucked with her the whirling wave,
Like one who grapples with his enemy,
And strives to strangle him before he die.

And first one universal shriek there rushed,
Louder than the loud ocean, like a crash
Of echoing thunder; and then all was hushed,
Save the wild wind and the remorseless dash
Of billows; but at intervals there gushed,
Accompanied with a convulsive splash,
A solitary shriek, the bubbling cry
Of some strong swimmer in his agony.

SECTION III.

SELF-HELP.

HERCULES and the Waggoner is an old fable and a true; but it is possible to read its moral wrong. "Help thyself, and Heaven will help thee," is a false saying, if it be taken to mean, "There is no appeal but to thine own *effort.*"

From the very first it was ruled by the Supreme that it is not good for man to be alone; and this ruling has determined not only the undesirableness, but also the impossibility of absolute solitude and self-containedness. Self-help is thus reduced to mean nothing more than personal energy in grasping other and extrinsic help. And unless this be distinctly recognised, all the examples which are now-a-days paraded of self-raised men must only tend to mislead those who are invited to imitate them.

Of universal application are the Apostle's questions—"Who maketh thee to differ from another? What hast thou that thou didst not receive?" No mere conventional allowance of the truth that there is a Supreme Giver from whom we have received, will serve as a sufficient answer to these questions. That great Giver of every good and perfect gift, gives largely what he gives, by the intervention of others, as if to force upon us the conviction that self-help is not of self after all. Who, my brother, made you a wiser or a wealthier man than your fellows? He, you say, whose name may not be lightly named. Yes, but *also* this or that other one whose name I may cite at once—His agent in helping you to be the wise or wealthy man you now are.

Let us take the career of one of the men most frequently named as an example of the power of self-help—William Herschel the eminent astronomer.

He is a musician, and plays the oboe in the band of the Durham Militia at Doncaster. For that Tyrtaean art of military music, he is in debt to the poor German musician his father; to say nothing of his debt to the mother that bare him, for the lungs to blow into his reed at all. At Doncaster, a certain Doctor Miller, having heard him perform a solo on the violin in a surprising manner, entered into conversation with him, and was so pleased, that he urged the youth to leave the militia band and *come to live at his house for a time.* Herschel did so, and, while at Doncaster, was principally occupied in violin-playing at concerts, at the same time availing himself of *the advantages of Dr Miller's library* to study in his leisure hours.

We thus see that he finds a helper in Dr Miller, and also that he has in himself such will and power of self-help, that he shall erelong leave concert-fiddling, as he has left oboe-blowing, to read off that "music of the spheres" of which God's right hand has written the score on the blue page of heaven, with planets for notes, and the twinkle of the stars for quavers. While officiating at Halifax as organist, "he began," says the author of a popular book on "Self-Help," "to study mathematics, *unassisted by any master*," save, we must take leave to add, by one so long dead and gone as he who set forth axioms of geometry at the court of an Alexandrian Ptolemy! "Some recent discoveries in astronomy having arrested his mind"—surely the discoverers were helpers to the man—"and awakened in him a powerful spirit of curiosity, *he sought and obtained from a friend* the loan of a two-foot Gregorian telescope." So, there is the self-helper gone star-gazing at last, with a two-foot telescope *lent him by a friend!*

No mere self-help, then, was it that made Herschel the great astronomer of his time. He had at least the help of old Euclid and of a two-foot telescope. And as with Herschel, so is it, and so has it ever been, with the whole class of what are called self-raised and self-educated men. Has a man's education come by books? It is with only the widest mental reservation we may say "Here is a man self-educated." He is debtor not merely to the thinkers, reasoners, tale-tellers, song-singers, students, and teachers who have lived before him, but even to the mechanical perpetuators of their acquisitions, from Cadmus to Gutenberg, and their latest successors in the type-foundry or the compositor's room. And what of the man whose education has come rather by tools than by books? Has not his self-help left him debtor also to all the generation of the sons of Tubal Cain? Cunning human brains, through skilful human hands, have passed into those lifeless agents, by which he effects his designs. Hammer-help and chisel-help, help of rude water-wheel, or help of steam-power, all is man-help and brother-help to the most independent and self-reliant of *so-called self*-helpers. We grant that, when the human brotherly agent is unseen, it is hard for us, who are so slow to "walk by faith," to feel the personal obligation keenly. But the fact is undeniable that the book which we study, or the tool which we use, is really a personal emanation, and therefore lays us under obligation to some human helper. Trite as the saying is, it is none the less true that the copies of the Gospel which its Divine Author set in circulation to convert the world, were written on twelve human hearts and brains, and bound in twelve human bodies.

Macmillan's Magazine.

ORGANS AND FUNCTIONS OF PLANTS.

PLANTS are classified into three divisions, corresponding to the threefold structure of the seed. Plants of the first division are called *Dicotyledons*, because in them the seed is composed of two cotyledons or seed-lobes. Those of the second division are called *Monocotyledons*, because their seeds consist of only one cotyledon; while the term *Acotyledons* is applied to plants—such as ferns, mosses, and lichens —which have no seeds, properly so called, and consequently no cotyledons. While Dicotyledonous and Monocotyledonous plants grow from seed, the Acotyledons are propagated by minute granular bodies, called spores or sporules, which are really nothing else than distinct plants, disjoined in a living state from the parents. Plants of the first division are also called *Exogenous*, and those of the second, *Endogenous*, from the different mode in which the stem is formed in each. In the stem of the former, new matter is formed by successive layers on the *outside;* in that of the latter, by successive layers on the *inside*, or towards the centre.

Plants have two sets of organs, which perform the function of nutrition and the function of reproduction.

The *nutritive* organs are the root, the stem, and the leaves. The *root* gives stability to the plant in the soil, and, by the *fibrils which* it sends forth, collects materials for its food. For *this latter purpose,* the fibril roots, as well as the main root itself (the *caudex*), are provided with soft porous terminations, which are called *spongioles*, from their peculiar efficacy in imbibing the surrounding moisture. When the moisture, which contains various nutritive substances, has been absorbed by the roots, it ascends (under the name of *sap*) through the stem to the *leaves*, where part of it is exhaled, and the remaining part subjected to an important chemical change, rendering it fit for being digested and assimilated. The way in which the leaves elaborate the sap into digestible food is unknown, though it is certain that they expose it to the action of air and of light, and also that they inhale from the air carbonic acid, decompose it, and then appropriate the carbon, which is known to be the main constituent of plants. After being changed and enriched in the laboratory of the leaves, the sap is sent back to the various parts of the plant, that it may feed and nourish them. In *exogenous* plants, it descends through the outer rim —that is, through the *liber* and *alburnum*, the inner bark and new wood—but in *endogenous* plants, through the innermost layer of the structure, which is also the most recently formed. In its descent, the sap deposits the various secretions requisite for the nourishment, health, and growth of the stem, the bark, and other parts; and at last reaching the root, whence it first started, it imparts hardness and tenacity to the fibrils, and furnishes matter to form new spongioles.

But plants are also *generative*. A plant "hath seed in itself." Besides vitalizing that which is necessary to the growth and conservation of each of its own parts, it is endowed with the power of giving existence to a new whole, and of providing the germ with the nourishment necessary for it until it is able to commence its independent being.

The organs of reproduction (except in the case of flowerless plants) are all contained in what is botanically called the *flower*. The flower consists of four parts or whorls, as they are technically termed—the *calyx*, the *corolla*, the *stamens*, and the *pistils*. These are all believed to be merely *transformations of leaves*, altered so as to suit the particular functions which each performs. The *calyx* is the outer covering of the flower—the symmetrical cup in which it rests. It is usually of the same green colour as the leaves, though sometimes, as in the fuchsia and the Indian cress, it is otherwise coloured. The *corolla* is the blossom or flower, popularly so called. Its parts or leaflets, which are sometimes distinct and sometimes united, are termed *petals.* These petals are composed of a congeries of minute cells, each containing colouring matter; and as the cells are distinct from one another, the petals may be dark-coloured at one part, and light-coloured at another. No lover of flowers need be told how exquisitely diversified are these colours, and with what masterly skill they are arranged. The remaining organs—the *stamens* and *pistils,* on which the production of seed peculiarly depends—occupy the centre of the corolla. The *pistil* is a hollow tube or shaft, with a spongiole, named the *stigma,* at one end, and a *seed-vessel,* or ovary, at the opposite end. The *stamens* (which commonly surround the pistil) consist each of a stalk or filament, surmounted by a rounded vessel called the *anther,* which contains a fine fecundating powder, termed *pollen.*

Now, in order to reproduction, it is necessary that the fecundating pollen, which is produced and ripened in the anther of the stamens, should be conveyed to the stigma of the pistil, and thence sent down to the ovary. Mark how this process is effected. Generally, the stamens and the pistils are found on the same plant, and so arranged that the former overtop the latter. This arrangement enables the pollen, when it bursts from the anther, to fall on the stigma. In order to secure this purpose more effectually, the stigma exudes a slightly glutinous fluid, to which the grains of the pollen adhere; and each grain, moreover, on touching the glutinous matter, elongates itself into a shape which enables it to pass down through the pistil into the ovary, and so to convey to the germ the vivifying powder. Such is the usual arrangement; but it is not the only one. In drooping flowers—such as the fuchsia, where it would be obviously unfit that the stamens should exceed the pistil in length, because in that case the pollen would be scattered on the ground instead of reaching the stigma—the relation of the parts is inverted, the pistil being longer than the stamens. In the common nettle, the stamens have elastic filaments, which are at first bent down, so as to be obscured by the calyx; but, when the pollen is ripe, these filaments jerk out, and thus scatter the powder on the pistils. In the hazel, again, where the pollen is in one set of flowers, and the pistils on another, the leaves might interfere with the application of the pollen, and therefore they are not produced until it has been scattered. In trees, such as the willow, where the stamen-bearing flowers are on one tree, and the pistil-bearing flowers on another, the process of communication is effected in some cases by the wind, and in other cases by insects—as by the bee, which, while providing food for its young from the flowers, aids, at the same time, in the dispersion of the pollen.

When fecundation is completed, the other parts of the flower decay, while the ovary increases its bulk, till it becomes, under very diversified forms, what is called the *fruit;* and all these forms would seem to have one object in view, viz., the preservation of the seed. The production of this seed has been the great end of the whole process hitherto described; and, this end accomplished, the flower dies, while the energies of the plant are turned to the nursing of the little embryo which it has left behind.

When the seed, thus matured in the fruit, is deposited in the soil, a process of germination takes place under the influence of heat, air, and moisture. The embryo sends forth a number of fibrous threads, which fix the plant in the ground. The radicle becomes the root. The plumule, on the other side, elongates itself, rising into the air in the form of a stem. Erelong leaves shoot out, and new forms of floral beauty are evolved. And thus the great processes of nutrition and reproduction again proceed in the same varied and beautiful round.

Compiled.

LEAVES.

Leaves consist of fibres arranged in a kind of network. They are of various shapes and sizes. Some are so small as to be microscopic objects, and others—those of the Talipot palm, for instance—so large as to measure above 30 feet in circumference. They also fall at different times, and are differently denominated according to the period of their fall; being called caducous, deciduous, persistent, or perennial, according as they fall in summer, in autumn, in spring, or only in the course of years.

The function of leaves in elaborating the sap has been already pointed out. But their property of absorbing and perspiring moisture is also worthy of attention. A leafy branch, after being gathered, speedily withers in a dry atmosphere; but in a damp situation it retains its verdure for a time. Haymakers are quite familiar with the fact, that, in moist weather, it is next to impossible to get their hay-harvest lodged in safety; and every one has observed the effects of a hot day in causing plants to droop, and of a moist one in causing them to flourish. The great annual sunflower is said, in a hot dry day, to perspire in twelve hours, not less than 1 lb. 14 oz.; and the cornelian-cherry is a still more remarkable instance, for it evaporates moisture equivalent to twice the weight of the whole shrub in twenty-four hours.

The effect of light upon leaves is also worthy of notice. If not the actual cause of their green colour, it has at least some influence in making and keeping them green. Leaves raised in the dark are invariably of a sickly white colour; and the blanching of celery, it is well known, is effected by covering up the plant from the light. It is singular also, that light, whilst it benefits the upper, injures the under sides of leaves; and none can have attended to fruit-trees without remarking, that they invariably turn their leaves towards the light. If leaves are disturbed, they will turn again to their former position, and quicker, too, in proportion to the *intensity of light.* A field of clover follows the course of the sun as regularly as the sunflower, the marigold, and the daisy. We ought not to omit quoting, *en passant*, the striking remark of Sir J. E. Smith in reference to the flowers just mentioned, that Nature, in their forms, seems to have imitated the radiant luminary to which they are apparently dedicated. *Compiled.*

THE SEED.

THERE is no part of a plant which affords so many striking proofs of admirable contrivance as the seed. The care which Nature has bestowed upon it is astonishing. Independently of the numerous and admirable provisions for producing and perfecting it, the mode in which this organ is *preserved* after it is matured, evinces consummate care and wisdom. Sometimes it is packed up in a capsule, a vessel composed of tough and strong coats; sometimes, as in stone-fruits, it is enclosed in a shell, which again is enclosed in a pulp; sometimes, as in grapes, it is plunged overhead in a glutinous syrup contained within a skin or bladder; at other times, as in apples, it is embedded in the heart of a firm fleshy substance; or, as in strawberries, pricked into the surface of a soft pulp. These, and many other contrivances for preserving it, are found in what are called fruits. In pulse, grain, grasses, and ordinary trees and shrubs, the variety of the seed-vessels is incomputable. We have the seeds, as in the pea-tribe, regularly disposed in parchment pods, which completely exclude the wet; the pod itself also, being not seldom, as in the bean, lined with a fine down, distended like a blown bladder. We have the seed enveloped in wool, as in the cotton plant; lodged, as in pines, between the hard and compact scales of a cone; barricaded, as in the artichoke and thistle, with spikes and prickles; in mushrooms, placed under a penthouse; or we find it covered by a strong close tunicle, and attached to the stem, as in several kinds of grain and of grasses.

Equally numerous and admirable are the contrivances for *dispersing* seeds. Who has not listened, in a calm and sunny day, to the crackling of furze-bushes, caused by the explosion of their little elastic pods; or watched the down of innumerable seeds floating on the summer breeze, till they are overtaken by a shower, which, moistening their wings, stops their further flight, and at the same time accomplishes its final purpose by immediately promoting the germination of each seed in the moist earth! How little are children aware, as they blow away the seeds of the dandelion, or stick burs in sport on each other's clothes, that they are fulfilling one of the great ends of Nature! The awns of grasses answer the same purpose. Pulpy fruits serve quadrupeds and birds as food, while their seeds, often small, hard, and indigestible, pass uninjured through the intestines, and are deposited, far from their original place of growth, in a condition peculiarly fit for vegetation. Even such seeds as are themselves eaten, like the various sorts of nuts, are hoarded up in the ground, and occasionally forgotten, or carried to a distance, and in part only devoured. The ocean itself serves to waft the larger kind of seeds from their native soil to far-distant shores. *Compiled.*

GERMINATION.

Let us endeavour to illustrate the subject of Germination, by taking a view of what happens to a common bean after it has been committed to the earth.

A novice in the study will be surprised to find how nearly a bean resembles the egg which is daily placed before him at breakfast. In taste or flavour, indeed, the two entirely differ; but between the arrangements within the cover of the bean and those within the eggshell, there is a close similarity.

The rudiment of the future chick is so placed as to occupy the upper central part of the yolk or red part of the egg. All around this, and enclosed within suitable membranes, is the white, or albuminous part of the egg. This is the nutritious matter, which is to form the food of the little embryo, from the first day that hatching commences, onwards till brain, heart, stomach, and even the rudiments of claws and feathers are in due time developed. From the first day, a network of minute blood-vessels begins to shoot out over the membranes of the yolk; and day after day, these continue to absorb the white albumen, taking it up, and assimilating it into the bones and muscles of the chick; till at last, towards the end of the twentieth or twenty-first day, just as the creature is ready to burst its shell and come out into the sunny day, the whole yolk, or red part, is absorbed also, as a substantial luncheon, to serve it till it can pick up its dinner for itself.

Let us now turn to the bean. If we cautiously pick off the external covering, we shall find immediately under the dark spot or eye painted on its outside, the germ or embryo of the future plant, in appearance like a little pointed tongue. It, too, is snugly and conveniently situated between the meeting edges of the two lobes of the bean. Now these two lobes or cotyledons are also the provision store of the young bean-germ. They consist, as everybody knows, of solid bean flour, that is, of starch, sugar, and gluten—matters in no way different essentially from the white and red of the egg—but they have not, so to speak, undergone such an exquisite cookery. At least, the chick would not be disposed to say so, for fowls as well as men love the smack of sulphur with which the egg is charged, and also the higher artistic cookery which has been bestowed on the oxygen, nitrogen, and carbon. But to the bean-germ, which is less of an epicure than the chick, the bean-bread is all in all; only being dry, and perhaps hard with a year or two of age, it has to be moistened. No sooner is it put into the earth, than heat and moisture begin to work wonderful changes; the dry and inert meal starts into activity, and a fermentation commences, and goes on very much like the process of beer-making; till at last the bean-lobes become, in fact, a cup of good strong ale. In the meantime, a *change has come* over the bean-germ—a very different change, however, from what has taken place in the lobes. In the lobes, a simple chemical action has been induced, and a complete change of the elementary atoms has been the consequence. But the cells of the germ have been influenced in a very different way. A *vital* activity has entered into them, and they are already feeding upon and assimilating the liquid stores of the cotyledons. Soon rootlets and leaf-bud begin to be developed; and in due time the bean-germ, like the chick, bursts its cerements, and shoots forth a living plant, its roots pushing down with eagerness into the soil, there to draw their proper nourishment, and the leaf bursting out into the glorious summer-day, to wait upon and worship the sun, its presiding guardian.

British Quarterly Review.

USES OF PLANTS.

As the predominant ingredient in plants is carbon, so one of their chief uses seems to be to fix and consolidate this material in such a form as to make it available for the use of animals. Part of this carbon, taken in as food and air by animals, forms the material which generates and maintains their animal heat; the remainder becomes, in the shape of wood or of coal, the material which feeds our fires, and enables us to enjoy a sufficiently high temperature in the absence of the solar heat. Animals, by the process of respiration, exhale carbonic acid, which would in time vitiate the atmosphere, were it not that plants greedily absorb this acid, and, after appropriating the carbon, give out the oxygen, which in its turn is suited to the healthy respiration of animals.

Vegetable substances, either directly or indirectly, feed all animal beings. It would be somewhat curious to investigate how much of the actual food of man is derived solely from the vegetable kingdom. It is true we northern nations are exceedingly carnivorous; but in sunnier climes, the food of the great mass of the people is almost solely vegetable. [redacted], *maize, sago, yams,* and acidulous fruits, are the staple diet of the natives of warm climates. In Great Britain, many millions of quarters of wheat, barley, and other grains are consumed annually as food, and in the making of ale, beer, and spirituous liquors. The quantity of potatoes used is also very great; and in the mere matter of luxury, 48,000,000 lbs. of tobacco, 160,000,000 lbs. of tea, and 34,000,000 lbs. of coffee are also annually consumed within the United Kingdom.

Nor are we less indebted to the vegetable world for our clothes and warmth than for our food. In this country 13,000,000 cwts. of cotton are annually manufactured into various articles of clothing; and not fewer than 120,000,000 tons of coal, besides wood, are consumed as fire throughout the year. This same material of coal, indeed, which is undoubtedly a vegetable production, exhibits to us the amazing fecundity of the soil in ages long past, for if we take the coalfields of America, of Britain, of Belgium, and other parts of the world, we shall find that the mass of carboniferous matter thus stored up in subterranean cellars is almost beyond our powers of calculation. In the great valley of the Mississippi alone there is a coalfield of nearly 200,000 square miles.

The number of vegetable species that are useful to man far exceeds that of animals; and, what is remarkable enough, almost every fresh discovery of new countries brings to us some useful plant, while very *few* useful animals have been added to our stock for many centuries. The inestimable potato is of itself, perhaps, worth, in its economical use, nearly all the animals in the world. The Peruvian bark, the source of our quinine, with many other useful medicines, we also owe to the New World; while the Eastern Archipelago contributes to us one of the most universally useful gums, the Gutta-Percha.

But apart from the important uses of vegetables in the economy of the world, plants are, as it were, the poetry of nature, the gilding and embroidery of the plains and valleys, the splendid arborescent plumes of the mountains. With that superabundant beneficence which the Author of Nature displays in all His arrangements, the vegetable world, besides furnishing man with the materials of food and clothing, also ministers to his delight in the beautiful. There is a refinement and delicacy in the forms and colours of plants: their organic elements are more purely compounded as regards the senses of man, than those of animals; even their decay and decomposition are less offensive than those of animals. To plants we owe all the pure and ethereal sensations of smell—our finest essences, our most aromatic oils, our nard, cassia, and attar of roses. When the most enthusiastic poet sings of the exquisite beauty of his mistress, he can only compare her to the lily. When we wish to adorn the young and blooming bride, we deck her with the rose, or with the more modest jasmine or myrtle. When we desire to soothe our bereavements by paying honour to the corse of the departed friend, we strew flowers of appropriate memorial on the grave.

British Quarterly Review.

YARDLEY OAK.

THOU wast a bauble once, a cup and ball
Which babes might play with; and the thievish jay,
Seeking her food, with ease might have purloined
The auburn nut that held thee, swallowing down
Thy yet close folded latitude of boughs,
And all thine embryo vastness at a gulp.
But Fate thy growth decreed; autumnal rains
Beneath thy parent tree mellowed the soil,
Designed thy cradle; and a skipping deer,
With pointed hoof dibbling the glebe, prepared
The soft receptacle in which, secure,
Thy rudiments should sleep the winter through.

Thou fell'st mature; and in the loamy clod,
Swelling with vegetative force instinct,
Didst burst thine egg, as theirs the fabled Twins,
Now stars; two lobes, protruding, paired exact;
A leaf succeeded, and another leaf;
And all the elements thy puny growth
Fostering propitious, thou becamest a twig.

Who lived when thou wast such? Oh, couldst thou speak,
As in Dodona once thy kindred trees
Oracular, I would not curious ask
The future, best unknown, but at thy mouth
Inquisitive, the less ambiguous past!
By thee I might correct, erroneous oft,
The clock of history, facts and events
Timing more punctual, unrecorded facts
Recovering, and misstated setting right—
Desperate attempt, till trees shall speak again!

Time made thee what thou wast—king of the woods;
And time hath made thee what thou art—a cave
For owls to roost in. Once thy spreading boughs
O'erhung the champaign; and the numerous flock
That grazed it stood beneath that ample cope
Uncrowded, yet safe sheltered from the storm.
No flock frequents thee now. Thou hast outlived
Thy popularity, and art become
(Unless verse rescue thee awhile) a thing
Forgotten, as the foliage of thy youth. COWPER.

THE FIGURES OF SPEECH.*

Figurative language is opposed to *ordinary*, *plain*, or *literal* speech; and a figure of speech may be defined to be a distinguished mode of speech which results from a peculiar state of mind suited to itself, and expresses the thought of a writer or speaker more vividly and happily than ordinary language. Thus, when we say of vicious indulgence, "that the enjoyment of it is short, the recollection bitter and lasting," we express a common idea in common language. When we use the lines—

"Pleasure known but by its wings,
And remembered by its stings"—

we convey the same idea in the language of figure. Figures are the language of nature, not an invention of art; and however bold, or even apparently absurd, they originate in the principles of our constitution. In the use of them, the vulgar are often more correct than the learned; the former speaking as nature prompts, the latter attempting to forge them by study, from an affectation of ornament.

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* The substance of this lesson is taken from an ingenious Essay *on the Figures of Speech*, by the late Rev. Alex. Carson of Dublin.

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1. The figures which are founded on resemblance, are the *metaphor*, the *comparison* or *simile*, and the *allegory*.

The *metaphor*, the most common of all the figures, substitutes one thing for another, and applies to the primary object language which is, strictly speaking, descriptive only of the secondary. Thus, in Wolsey's description of the state of man, "To-day he puts forth the tender leaves of hope, to-morrow blossoms," a tree is put for man, and changes, which can in strictness be predicated only of the secondary, tree, are attributed to the primary, man.

Comparison, or *simile*, is founded on resemblance, as well as metaphor, but has nothing else in common with it. Metaphor always asserts what is manifestly false; comparison asserts nothing but what is true. The former asserts that one object has the properties of another; the latter, that one object resembles another. The two figures, though near akin, have a distinct personality; they are sisters, the daughters of Likeness by different fathers.

Allegory is sometimes described, but incorrectly, as a continued metaphor. The two figures are quite distinct, and characterized by different properties. Allegory presents to immediate view the secondary object only; metaphor always presents the primary also. Metaphor always imagines one thing to be another; allegory, never. Everything asserted in the allegory is applied to the secondary object; everything asserted in the metaphor is applied to the principal. In the metaphor there is but one meaning; in the allegory there are two, a literal and a figurative. The following example, from the 80th Psalm, is one of the finest allegories:—

"Thou hast brought a vine out of Egypt: thou hast cast out *the heathen, and planted* it. Thou preparedst room before it, and didst cause it to take deep root, and it filled the land. The hills were covered with the shadow of it, and the boughs thereof were like the goodly cedars. She sent out her boughs unto the sea, and her branches unto the river. Why hast thou then broken down her hedges, so that all they which pass by the way do pluck her? The boar out of the wood doth waste it, and the wild beast of the field doth devour it. Return, we beseech thee, O God of hosts: look down from heaven, and behold, and visit this vine."

Allegory is a figure much seldomer employed than either metaphor or simile. The latter figures are frequently used by us, not only without any previous study, but even without any sensible exertion of the imagination; but to form an allegory the mind must look out for a likeness that will correspond in a variety of circumstances, and form an independent whole. The best occasion for allegory is, when it is of importance to gain a man's own judgment against himself, without exciting his suspicions of our intention. We all know the effect of the parable spoken to David by Nathan; and we cannot fail to observe that no other form of speech could have supplied the place of allegory. Many of the parables of Christ are of the same description; and the Scribes and Pharisees were often obliged to give judgment against themselves.

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2. *Irony*, *Hyperbole*, and *Interrogation*, may be considered as belonging to one class, as in all the three there is an apparent inconsistency between the literal and the figurative meaning. *Irony* employs words in a sense contrary to their literal meaning. Contempt employs it as one of its peculiar weapons.—"You are a pretty fellow!" And there is one very biting species of it, by which a person confesses himself guilty of that of which another is guilty, whom he wishes to expose. Sometimes the strongest manner of denying a thing is by confessing it with an indignant ironical air; and there is often no better way of getting rid of an unreasonable arguer than by ironically agreeing with him.—*Hyperbole* consists in describing a thing as greater than the reality; but, *however wild, it* does not mean to deceive us. It is

extravagant only in words. We have a fine instance of this figure in the assertion of the Evangelist, that if all the works of Jesus had been recorded, the whole world would not have held the books.—*Interrogation* implies *literally* ignorance or doubt; *figuratively*, the strongest confidence of conviction. It not only communicates force and fire to the style of the speaker, but conveys to the hearers a conviction of his earnestness and fearless honesty. It is the clearest form in which an argument can be presented to the mind, and therefore the best calculated to produce conviction. It brings an audience to a point, and obliges them to decide.

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3. *Antithesis* and *Climax* are figures of arrangement. *Antithesis* arranges the members of a section, so as, by contrast, to make objects more striking. The famous example from Cicero shows how well it is calculated to strengthen the impression which an orator intends to make:—"Is it credible that, when he declined putting Clodius to death with the consent of all, he should choose to do it with the disapprobation of many? Can you believe that the person whom he scrupled to slay,—when he might have done so with full justice, in a convenient place, at the proper time, with secure impunity,—he made no scruple to murder against justice, in an unfavourable place, at an unseasonable time, and at the risk of capital condemnation?"—*Climax* arranges its matter so that every succeeding object or circumstance rises above that which preceded. It has a grand effect where it has scope and is well managed; but it is proper only for things of importance. The noted example from Cicero against Verres is a fine one:—"It is highly criminal to bind a Roman citizen; to scourge him is enormous guilt; to kill him is almost parricide; but by what name shall I designate the crucifying of him?" And a still finer example is furnished by the words in which the messenger conveyed to Eli the issue of the battle between the Israelites and the Philistines:—"Israel is fled before the *Philistines; and there* hath been also a great slaughter of

the people; and thy two sons also, Hophni and Phinehas, are dead; and the ark of God is taken!"

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4. *Ellipsis* is prompted by great emotion, and expresses the thought in a hurried and incoherent manner. It passes with rapidity from one thing to another, without pointing out the connexion between them; and the phraseology which it employs is often ungrammatical and disjointed. We have a fine example in the words of Isaac, on discovering that he had been deceived in conferring the blessing,—"Who—where is he that hath taken venison and brought it me?"—*Pleonasm* is the opposite of ellipsis. The latter hurries over its objects, the former detains them as long as possible; and both modes of speech, though directly opposite, are alike founded in nature, and alike available to the purposes of the poet and the orator. They cannot indeed both be beautiful in the same situation; but each has its proper place, which could not be supplied by the other. Pleonasm employs a redundancy of expression, but only because such redundancy is necessary to express the deep impression on the mind of the speaker. Milton speaks thus with respect to his blindness:—

> "Nor to these idle orbs does day appear,
> Or sun, or moon, or stars, throughout the year,
> Or man, or woman."

After stating that he did not perceive the light of day, we needed not to be informed that he could not discern the sun, or moon, or stars. But the person who should call this tautology would be as devoid of soul as an orang-outang. We can participate in the feelings of the poet, and brood with him over the objects of his regret. It soothes his melancholy to dwell on his bereavement, and it gives us a sad pleasure to accompany him. It is from a like principle that earnestness expresses its object again and again in nearly the same words: "Lord, hear my voice; let thine ear be attentive to the voice of my supplications; hear my prayer, O Lord, and let my cry come unto thee!" There is nothing more affecting in language than David's lamentation for the death of his wicked son Absalom, which is just a combination of this figure and apostrophe. It is the very soul of sorrow. "And the king was much moved, and went up to the chamber over the gate, and wept: and, as he went, thus he said, O my son Absalom, my son, my son Absalom! would God I had died for thee, O Absalom, my son, my son!"

5. *Personification* gives life and intelligence to inanimate objects; but it does not imply any conviction, even the most momentary, of actual life and intelligence in the thing personified. We make the supposition, and enjoy all the advantages of it, though we are quite aware that we are figuring a thing to be what we know it is not. The chief intention of this figure appears to be a desire of giving vivacity to style, and, in the higher kinds of it, of giving vent to overpowering feeling.

6. *Apostrophe* addresses the absent or the dead, or, from the influence of passion, turns from the regular object of address to the person spoken of. David's lamentation for his son Absalom is one of the most affecting examples of an address to the dead. Cuthullin's address to his far-distant wife is the voice of nature:—"Strike the harp in praise of Bragela, whom I left in the isle of mist, the spouse of my love. Dost thou raise thy fair face from the rock to find the sails of Cuthullin? Retire, for it is night, my love, and the dark winds sigh in thy hair. Retire, for I will not return till the storm of war is gone."

7. *Exclamation* assumes the form of an address, but it expects no reply. It asks,—not to be informed, but to express the strong conception which it has of its object. Interrogation and exclamation are often unskilfully confounded. The difference is this:—Interrogation, when a

figure, always strongly asserts, and is used in argument; exclamation expresses agitated feeling, admiration, wonder, surprise, anger, joy, grief, with respect to something that is not controverted:—"O the depth of the riches both of the wisdom and knowledge of God! How unsearchable are his judgments, and his ways past finding out!" Personification, apostrophe, exclamation, and metaphor, may all be combined:—"How art thou fallen from heaven, O Lucifer, son of the morning!"

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8. *Vision* represents a past or future action or event as happening before our eyes. Instead of merely narrating their substance, vision gives the very words of another. A writer, commencing the account of an action or event in his own words, abruptly begins to repeat the words of the speaker of whom he is writing:—

"Thus, at their shady lodge arrived, both stood,
Both turned, and under open sky adored
The God that made both sky, air, earth, and heaven,
(Which they beheld), the moon's resplendent globe,
And starry pole:—'Thou also madest the night,
Maker Omnipotent, and thou the day!'"

Vision effects its purposes also by placing the speaker on the spot where the action or event happens, and by causing him to assume the direction of what takes place. He gives orders with uncontrolled authority, with respect to things over which he has not the smallest influence. He addresses the spectators on every important occasion, and they can see nothing but as he directs their attention. The following picture of the fatal inactivity of the Scottish army at Flodden is a fine instance of commingled apostrophe and vision:—

"And why stands Scotland idly now,
Dark Flodden! on thy airy brow,
Since England gains the pass the while,
And struggles through the deep defile?
What checks the fiery soul of James?
Why sits that champion of the dames

Inactive on his steed,
And sees, between him and his land,
Between him and Tweed's southern strand,
His host Lord Surrey lead?
What 'vails the vain knight-errant's brand?—
O, Douglas, for thy leading-wand!
Fierce Randolph, for thy speed!
O, for one hour of Wallace wight,
Or well-skilled Bruce, to rule the fight,
And cry,—'St Andrew and our right!'
Another sight had seen that morn,
From Fate's dark book a leaf been torn,
And Flodden had been Bannockburn!"

SIMILES FROM THE POETS.

"THAT strain again;—it had a dying fall:
O, it came o'er my ear like the sweet south,
That breathes upon a bank of violets,
Stealing and giving odour." SHAKSPEARE.

O CASSIUS, you are yoked to a lamb
That carries anger, as the flint bears fire;
Who, much enforced, shows a hasty spark,
And straight is cold again. *Id.*

THE superior fiend
Was moving toward the shore: his ponderous shield,
Ethereal temper, massy, large, and round,
Behind him cast; the broad circumference
Hung on his shoulders like the moon, whose orb
Through optic glass the Tuscan artist views
At evening from the top of Fesolè,
Or in Valdarno, to descry new lands,
Rivers, or mountains, in her spotty globe. MILTON.

HER feet beneath her petticoat,
Like little mice stole in and out,
As if they feared the light. SUCKLING.

For Loyalty is still the same,
Whether it win or lose the game;
True as the dial to the sun,
Although it be not shined upon. **Butler.**

Dim, as the borrowed beams of moon and stars
To lonely, weary, wandering travellers,
Is Reason to the soul: and as on high
Those rolling fires discover but the sky,
Not light us here; so Reason's glimmering ray
Was lent not to assure our doubtful way,
But guide us upward to a better day.
And as those nightly tapers disappear
When day's bright lord ascends our hemisphere,
So pale grows Reason at Religion's sight,—
So dies, and so dissolves in supernatural light.
Dryden.

True ease in writing comes from art, not chance,
As those move easiest who have learned to dance.
Pope.

But in his duty prompt at every call,
He watched and wept, he prayed and felt for all;
And, as a bird each fond endearment tries,
To tempt its new-fledged offspring to the skies,
He tried each art, reproved each dull delay,
Allured to brighter worlds, and led the way.
Goldsmith.

To them his heart, his love, his griefs were given,
But all his serious thoughts had rest in heaven.
As some tall cliff, that lifts its awful form
Swells from the vale, and midway leaves the storm;
Though round its breast the rolling clouds are spread,
Eternal sunshine settles on its head. *Id.*

But pleasures are like poppies spread,
You seize the flower, its bloom is shed;
Or like the snow-fall in the river,
A *moment* white—then melts for ever;

Or like the borealis race,
That flit ere you can point their place;
Or like the rainbow's lovely form,
Evanishing amid the storm. BURNS.

IT was a fair and mild autumnal day,
And earth's ripe treasures met the admiring eye,
As a rich beauty, when her bloom is lost,
Appears with more magnificence and cost. CRABBE.

MY soul, though feminine and weak,
Can image his: even as the lake,
Itself disturbed by slightest stroke,
Reflects the invulnerable rock. SCOTT.

'TWAS thine own genius gave the final blow,
And helped to plant the wound that laid thee low:
So the struck eagle, stretched upon the plain,
No more through rolling clouds to soar again,
Viewed his own feather on the fatal dart,
And winged the shaft that quivered in his heart.
BYRON.

MAN is but dust:—ethereal hopes are his,
Which, when they should sustain themselves aloft,
Want due consistence; like a pillar of smoke,
That with majestic energy from earth
Rises, but, having reached the thinner air,
Melts, and dissolves, and is no longer seen!
WORDSWORTH.

BEHIND them, Rome's long battle
Came rolling on the foe,
Ensigns dancing wild above,
Blades all in line below.
So comes the Po in flood-time
Upon the Celtic plain:
So comes the squall, blacker than night,
Upon the Adrian main.

Now, by our Sire Quirinus,
  It was a goodly sight
To see the thirty standards
  Swept down the tide of flight.
So flies the spray of Adria
  When the black squall doth blow;
So corn-sheaves in the flood-time
  Spin down the whirling Po. MACAULAY.

AND while he waited in the Castle Court,
The voice of Enid, Yniol's daughter, rang
Clear through the open casement of the Hall,
Singing; and as the sweet voice of a bird
Heard by the lander in a lonely isle,
Moves him to think what kind of bird it is
That sings so delicately clear, and make
Conjecture of the plumage and the form,
So the sweet voice of Enid moved Geraint.

TENNYSON.

THE TIDES.

IT is surely strange that a puny globe, revolving at the distance of 239,000 miles from our earth, should lift the waters of the ocean, and compel huge ripples to course across its surface in regular succession. Yet such is the fact. Yonder, in the great silent sea which hides the mysteries of the South Pole, the water begins to heave under the attractive force of the moon,—or, as one might say, under the sinewy pull of the Man in the Moon. A broad wave is formed, which rushes, or seems to rush, to the north, for the particles have no progressive motion, but simply leap upwards, as if in a vain struggle to reach the moon. Following the course of that wave into the Indian Ocean, you find that in about twenty-two hours from the time of its appearance at the southern extremity of New Zealand, it is riding in the Delta of the Ganges. Meanwhile, another branch of the same great billow makes for the African coast, and rolls into the Atlantic after doubling the Cape of Good Hope. In six hours from the time of its entrance into this noble basin, it crosses the Line, and after a further voyage of ten hours, it flows into the mouth of the English Channel, prepared to wash the feet of the Ruler of the waves. Most lovingly does that broad billow twine round the home of Britannia. While one portion enters the Straits of Dover, another glides up the Irish Channel; and a third, sweeping along the western coast of Ireland, and curving round the Shetland Islands, actually descends the German Ocean, where it rejoins the advancing tide off the mouth of the Thames, as if to pay double honour to the maritime mistress of the world. And not less lingeringly than lovingly does it perform this part of its journey, for though in some stages of its progress it moves at the rate of 1000 miles an hour, it takes upwards of twenty hours to pass from Cape Clear, at the extremity of Ireland, to the Nore.

The sun, as well as the moon, acts with attractive force on the waters of the ocean. But as his distance is so immense, it is only when his attractive power acts either in the same direction as that of the moon, or in opposition to that of the moon, that its effect is observable. When the sun and moon are in conjunction, as at the time of new moon, or in opposition, as at the time of full moon, their combined action produces what are called spring-tides; but when the lines of their attraction are at right angles to each other, which happens at the quarters, or when the moon is in quadrature, we have the lowest or *neap-tides.*

The tides flow and ebb twice in the course of a lunar day, (24h. 50m. 28s.) or once in every 12½ hours, and the time of high water, like the moon's rising, is about fifty minutes later every day. The height to which the tides rise varies with the latitude and the situation. It is greatest at the equator; it diminishes as we recede from that circle; and near the pole there is scarcely any rise. In open situations the time of high water and the height of the tide are very regular, but when the tide-wave encounters obstructions, as on entering a land-locked estuary, or rushing through a narrow channel, the time of high water is much varied, and the height greatly *increased. In some* parts of the western coast of Britain, as at the mouths of the Severn and the Solway, the tide sometimes rises to forty feet. In the Bay of Fundy, it rises to sixty feet, and often so rapidly, that cattle feeding on the shore have been drowned before they could escape. In inland seas—as the Black Sea, the Baltic, and the Caspian—there is no perceptible tide, and in the Mediterranean the rise is quite inconsiderable. *Compiled.*

THE GULF STREAM.

NOTHING can be more surprising than to reflect that the ocean is traversed by streams which flow as regularly as the Amazon or the Mississippi on land. Channels have been dug out for them apparently in the great main, and for thousands of miles they pursue their course between walls of water. Some of these currents are *periodical*, others are *variable;* but the most important ones are *constant*, and, if followed, will conduct the navigator along the same settled route as surely as the Rhine will carry a tourist past Bonn and Cologne, who starts from Coblentz on his return to the sea.

By far the most influential of these currents is the famous Gulf Stream. Little as it may be appreciated by Englishmen in general, every inhabitant of this country has a greater interest in its flow than he has in the Thames or Tyne. It takes its rise in the Gulf of Mexico, though it may be regarded as a continuation of the mighty equatorial current which flows from the western coast of Africa across the Atlantic. Sucking up the sun's rays as it advances, and storing away the warmth for future use, it passes into the Mexican Gulf, where, as in a caldron, its waters are raised to the high temperature of 86°. It then sweeps through the Pass of Florida,—its heat being 9° more than the ocean can claim by virtue of its latitude,—and skirts the shores of North America, until it takes that remarkable bend off Nova Scotia and Newfoundland which throws its waters across towards the coast of Europe. One branch curves downwards and flits past the *Azores* to the south; the other glides northward in the direction of the British Isles and the Polar Sea. This splendid stream is supposed to be equal in volume to three thousand Mississippis. Its length, reckoning from its Mexican head to the Azores, is upwards of 3000 miles. Its velocity in the Gulf of Florida is about seventy-eight miles a-day, though its pace dwindles down to a sober flow of ten before it reaches the Azores. Its average performance is about thirty-eight miles in the four-and-twenty hours.

The great function of the stream is that of bearer of the tropical heat. It sets out, as we have seen, with a temperature of 86°. It cools but gradually as it advances, losing not more than 13° or 14° during its progress. So superior is its charge of caloric that the thermometer at once detects the difference between its fervid waters and the ocean around. The voyager feels that he is entering a warmer climate when he sails into the atmosphere which overlies its route. It has been calculated that the quantity of heat discharged over the Atlantic from the waters of the Gulf Stream in a winter's day would be sufficient to raise the whole column of atmosphere that rests upon France and the British Islands from the freezing point to summer-heat. Can anything be more palpable than the advantages of such a glowing river? If caloric could be stored up in casks, and whole fleets employed in conveying them from the tropics to the northern shores of Europe—some addressed to Britain, some to Norway, some to Spitzbergen—the marks of benevolent design could not be more vividly expressed. In point of latitude England corresponds with Labrador. But we know that the latter region is one where the climate is exceedingly harsh, where the winter is painfully protracted, where the vegetation is feeble and haggard, and where the animals are heavily furred to keep them warm. Had we been left in the same predicament, and compelled to subsist on our geographical allowance of heat alone, England would have been a frost-bitten realm, where fairs might have been held on the Thames every winter, and boys might have snowballed each other for half the year. Stop the Gulf Stream to-morrow, if that were possible—divert it in some other direction, so that its summer-laden waters should never approach the European shores

—and then poor John Bull would soon become a national pauper; and that oft-anticipated catastrophe, the ruin of the British Constitution, would assuredly ensue.

British Quarterly Review.

THE TREASURES OF THE DEEP.

WHAT hid'st thou in thy treasure-caves and cells,
  Thou hollow-sounding and mysterious Main?
—Pale glistening pearls, and rainbow-coloured shells,
  Bright things which gleam unrecked of, and in vain.
—Keep, keep thy riches, melancholy Sea!
    We ask not such from thee.

Yet more, the Depths have more! What wealth untold
  Far down, and shining through their stillness lies!
Thou hast the starry gems, the burning gold,
  Won from ten thousand royal argosies.
—Sweep o'er thy spoils, thou wild and wrathful Main!
    Earth claims not these again!

Yet more, the Depths have more! Thy waves have rolled
  Above the cities of a world gone by!
Sand hath filled up the palaces of old,
  Sea-weed o'ergrown the halls of revelry!
—Dash o'er them, Ocean! in thy scornful play—
    Man yields them to decay!

Yet more, the Billows and the Depths have more!
  High hearts and brave are gathered to thy breast!
They hear not now the booming waters roar,
  The battle-thunders will not break their rest:
—Keep thy red gold and gems, thou stormy grave—
    Give back the true and brave!

Give back the lost and lovely! those for whom
  The place was kept at board and hearth so long,
The prayer went up through midnight's breathless gloom,
  And the vain yearning woke 'midst festal song!
Hold fast thy buried isles, thy towers o'erthrown,—
    But all is not thine own!

To thee the love of woman hath gone down,
  Dark flow thy tides o'er manhood's noble head,

O'er youth's bright locks and beauty's flowery crown;
—Yet must thou hear a voice—Restore the Dead!
Earth shall reclaim her precious things from thee—
Restore the Dead, thou Sea!

MRS HEMANS.

PRICES AND THEIR FLUCTUATIONS.

THE price of any commodity—or, in other words, the value of that commodity measured in money—depends, in the first instance, on the cost of its production. No article can be produced without some cost; and it is this cost of production, together with an additional sum for profit, which determines the price that the producer puts upon the article. Before coal, for example, can be brought to market, much expense has to be incurred by the coal-owner. The land or the mine from which it is excavated has to be paid for; colliers have to be paid for excavating it; the steam-engine and other machinery employed in raising it to the surface have to be paid for. These three things—material, labour, and machinery—have all to be paid for, before any coal can be produced; and the cost of these things, with the addition of something for profit, must obviously determine the price at which the coal-owner can afford to offer it for sale.

But does the producer always get the price he has fixed? He does not. Sometimes he gets a higher price, and sometimes a lower; sometimes he makes a larger profit than he counted on, and sometimes he has to sell at a loss. Now, this fact shows that though the price which the seller puts on his goods depends on the cost of production, yet the actual price which his goods fetch in the market depends, not on the cost of production alone, but on other causes or conditions also. And the question arises, What are these other causes or conditions? An example will help us of answer the question.

A butcher, let us suppose, takes to market a quantity of meat, which, after reckoning the cost of production, and *adding a fair profit*, he is able to sell at ninepence a-pound.

For some time he finds a ready sale at that price; but, as the day advances, the sale slackens, and at last no purchasers are to be found who will give that price. How is he to dispose of the portion of his meat still unsold, for it will spoil if left on his hand till next market-day? It is obvious, that he can now sell it only by reducing the price, so as to enable some to buy who otherwise could not afford to do so. Accordingly, rather than lose his meat, he sells it at whatever price it will fetch—it may be at eightpence, or sevenpence, or even at a sum which not only leaves him no profit, but causes him a loss. In this case, the butcher first fixes his price according to the cost of production, but is afterwards obliged to reduce it, because the quantity for sale is greater than the quantity wanted at the price, or, in other words, because the *supply is greater than the demand.*

On the other hand, let us suppose that the butcher, after selling for some time at ninepence, finds his meat going off so fast as to show that there is much more meat wanted than he has for sale; does he continue to charge only ninepence? No. Perceiving that there is not enough of meat for all who want it, and that some will give a little more for it rather than go without it, he raises his price, and probably gets tenpence or a shilling for what in the earlier part of the day he got only ninepence. In this latter case, the price rises, because the quantity wanted is greater than the quantity for sale, or, in other words, because *the demand is greater than the supply.*

Now, what is true of the price of butcher-meat, is equally true of the price of every other commodity. The seller fixes his price according to the cost of production, and when the demand is equal to the supply he gets that price; but whenever the demand and the supply are unequal, he has to vary his price—lowering it when the supply exceeds the demand, and raising it when the demand exceeds the supply.

But on what do supply and demand depend? what causes *them* to fluctuate?

There are two things on which the supply of commodities chiefly depends. One is the state or vicissitudes of the weather; for a bad harvest cannot but cause a greatly diminished supply of food—a failure in the cotton crop cannot but lessen the supply of one of the chief materials of clothing. The other is, the skill and industry of the producers; for while a good farmer will be able, by foresight and activity, to raise and reap a considerable crop in spite of the badness of the season, an unskilled and careless farmer may, in the same circumstances, lose his whole crop. But supply is also, to some extent, dependent on the state of demand. Manufacturers find it to be their interest to produce commodities only in such quantities as they can sell at a profit; and hence they enlarge or lessen the supply according as the demand increases or decreases.

The supply of commodities, then, depends on the state of the weather, the industrial ability of the producers, and the state of demand. The demand for commodities, on the other hand, depends chiefly on what may be called their desirableness,—that is, their usefulness or attractiveness in the eye of purchasers. Thus, there is a greater demand for iron than for lead, for paper than for parchment, for steel-pens than for quills. In like manner, necessaries being more desirable than luxuries, the demand for the former is less fluctuating than the demand for the latter. Other things, however, besides desirableness affect demand. For instance, fluctuations in the supply of some commodities will affect the demand for others. A bad corn-harvest must give rise to an increased demand for potatoes, rice, and other articles, which can be substituted for bread; while, on the other hand, an abundant corn-harvest, by placing bread within the reach of most buyers, must diminish the demand for potatoes and other inferior kinds of food. The price of a commodity, too, while itself dependent on the demand, reacts upon the demand, and modifies it. Of two things which are equally desirable, there is always a greater demand for the cheaper. It is the high price of gold watches which causes them to be less in demand than silver watches; it is the lower price of fustian jackets that causes working-men to purchase them in preference to coats of broadcloth.

Accordingly, manufacturers always find that by cheapening the price of their goods they increase the demand for them, and that by raising the price they lessen the demand. A large increase in the price of shoes would cause many who now wear them to go barefooted; while a large reduction of price would cause many to be well-shod who are now shoeless.

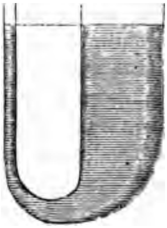
It is right, however, to add, that these various causes of fluctuation in supply and demand are themselves controlled by other causes which tend to keep the supply of commodities and the demand for them tolerably equal upon the whole. Suppose a publisher to bring out a new book which he expects to sell well, but which, in point of fact, does not sell. He is, of course, a loser by the venture—he loses all he has expended on paper, printing, and binding—and the reason of his loss is, that he has produced a book which was not wanted. What effect will this loss have upon him? Why, it will cause him to take greater pains in future to find out what is really wanted by the public, and to produce only such a book as is wanted. Or let us suppose him to produce a book which is very much wanted. It commands a ready and extensive sale, and yields him a large profit. Encouraged by this large profit, he brings out edition after edition, until at last the supply exceeds the demand, and he is left with a stock of unsaleable copies which are a dead loss to him. Here, again, he is punished by loss for having produced more than was wanted; and the effect will be to make him yet more careful to keep the supply of his commodities rather below than beyond the demand.

Such is the way in which *over-production* is controlled and corrected. In cases of *under-production*—that is, where the goods supplied fall short of the demand for them—the inequality is removed by the operation of what is called *competition.* As an article is sure to rise in price and to yield a large profit whenever the supply is short of the demand, other persons, besides the original producer, are naturally tempted by the hope of profit to produce and bring to market that article; and the effect of such competition is, of course, to increase the supply and remedy the previous under-*production.*

In these ways it is that supply and demand are kept, upon the whole, equal or nearly equal. It is a part of every producer's business to know how the supply and demand stand—or, as it is called, "the state of the market"—and to regulate production accordingly. Producers who do not attend to this are soon driven out of business by their losses. *Compiled from* TEMPLAR *and* DAWES.

PRESSURE OF WATERY FLUIDS.

ALL the particles of fluids are so connected together, that they press equally in every direction, and are equally pressed upon; each particle presses equally on all the particles that surround it, and is equally pressed upon by these; it equally presses upon the solid bodies which it touches, and is equally pressed upon by those bodies. From this, and from its gravity, it follows, that when a fluid is left to itself, its surface will rise or fall so as to settle at the same level. Hence, if we pour water or any other liquid into a tube or pipe bent double like a U, it will stand at the very same height in both limbs. Nor does it make any difference if one limb is wider than the other. Generally, and in every case, if there be two tubes or limbs of a tube connected together, however different their width, a fluid poured into them will stand at the same level, and thus a portion of fluid, however small, will resist the pressure of a portion, however large, and balance it.



From these considerations two most important conclusions follow. The one is, that water, by being confined in pipes or close channels of any kind, will rise to the height from which it came—that is, as high as its source—and upon this principle depend all the useful contrivances for conveying water by pipes, in a way far more easy, cheap, and effectual than those vast buildings called aqueducts, by which the ancients carried their supplies of water in artificial rivers over arches for many miles. The other is far more extraordinary; it is, that the pressure of the water upon any object is not at all in proportion to the bulk of the water, but only to the size of the surface on or against which it presses, and its own height above that surface; in other words, that any quantity of water, however small, may be made to support any quantity, however great. This principle is called the *Hydrostatical paradox; paradox* signifying something which, though true, appears, when first considered, to be untrue. We are at first startled by the apparent impossibility of the statement. But when we come to examine it more closely, we find it to be accurately true; for the small tube in the case just mentioned may be made ever so narrow, and to hold ever so little water, while the wide tube communicating with it may be made ever so large, and to hold ever so much water: yet the level at which the water stands in both tubes will be the same.

Everything thus depending upon the height and the surface, and nothing upon the bulk of the fluid, we may easily perceive what mischief may be sometimes done by a very small quantity of water. Thus, if you fix a small strong pipe in the bunghole of a cask of water, and pour water through the pipe till it rises in the pipe to a sufficient height, the barrel will burst, although but a very small quantity of water may have been poured into the pipe.

The same effect may be produced naturally, by the rain falling into and filling some long narrow chink or fissure that communicates with an enclosed body of water. Suppose, in the bowels of some mountain there should be an empty space of ten yards square and only an inch deep, in which a layer of water had lodged so as to fill it entirely; and suppose that in the course of time, a small crack of no more than an inch in diameter should be worn from above 200 feet down to the layer of water; if the rain were to fill this crack, the mountain would be shaken, perhaps rent in pieces with the greatest violence, being acted on by a force equal to the pressure of above 5000 tons of water, though not above *a ton and* a half altogether had been actually applied. This prodigious power, however, may be applied safely, and even beneficially. In the operations of Nature it is probably an important agent; and it is capable of being applied advantageously in the operations of art.

BROUGHAM.

WELLINGTON'S ARMY IN PORTUGAL.

A VARIOUS host they came—whose ranks display
Each mode in which the warrior meets the fight;
The deep battalion locks its firm array,
And meditates his aim the marksman light;
Far glance the lines of sabres flashing bright,
Where mounted squadrons shake the echoing mead;
Lacks not artillery breathing flame and night,
Nor the fleet ordnance whirled by rapid steed,
That rivals lightning's flash, in ruin and in speed.

A various host—from kindred realms they came,
Brethren in arms, but rivals in renown—
For yon fair bands shall merry England claim,
And with their deeds of valour deck her crown.
Hers their bold port, and hers their martial frown,
And hers their scorn of death in freedom's cause,
Their eyes of azure, and their locks of brown,
And the blunt speech that bursts without a pause,
And freeborn thoughts, which league the Soldier with the Laws.

And, O! loved warriors of the Minstrel's land!
Yonder your bonnets nod, your tartans wave!
The rugged form may mark the mountain band,
And harsher features, and a mien more grave;
But ne'er in battle-field throbbed heart so brave
As that which beats beneath the Scottish plaid;
And when the pibroch bids the battle rave,
And level for the charge your arms are laid,
Where lives the desperate foe that for such onset staid.

Hark! from yon stately ranks what laughter rings,
Mingling wild mirth with war's stern minstrelsy,
His jest while each blithe comrade round him flings,
And moves to death with military glee:

Boast, Erin, boast them! tameless, frank, and free,
In kindness warm, and fierce in danger known,
Rough Nature's children, humorous as she;
And HE, yon Chieftain—strike the proudest tone
Of thy bold harp, green Isle!—the Hero is thine own.

SIR WALTER SCOTT

BENEFICIAL EFFECTS OF THE GOSPEL.

To ascertain the effects of the Gospel upon mankind, we must of course summon History as our witness. Yet on this subject the testimony of History, though reliable as far as it goes, must necessarily be incomplete. The grand design of the Gospel is to convert and save souls: but what cognizance can History take of the precise extent to which mankind have been savingly converted? Conversion is a change effected upon the soul and within it; whereas it is only of outward and visible changes that History can apprize us. Nor even as regards the latter can it show us the whole truth. The scenes where spiritual religion yields its most abundant fruits are not those which History frequents — courts, camps, and the high places of the earth. Its sphere of triumph is the secluded walk of private life. Its hopes and consolations are most fully known and felt by the bereaved, the sick, the dying. In fact, it is only when the Gospel has become so widespread in its influence as to act upon the usages and institutions of a country, that its effects can engage the attention of the Historian. And hence, whenever he does bear testimony to the power of the Gospel, that testimony may be fairly held to mean a great deal more than it expresses.

Yet, though History does not and cannot acquaint us with *all* the effects of the Gospel, or even with its noblest triumphs, it does tell us enough to prove that the Gospel has really changed the world. For what are the actual effects of the Gospel as certified by History?

One of these effects is a marked improvement in men's physical condition. Wherever Christianity comes, its benign influence is soon seen in the increase of men's material comforts and the altered features of the scenery around them. Go with the traveller to some barbarous coast which is beginning to be dotted with missionary settlements, and mark what meets your eye. You travel through the region which is still Heathen, and find it as much a waste as the minds of the inhabitants—no cultivation, no houses, no industrial arts. But when you reach the missionary settlement, what a pleasing contrast is presented! Yet these native Christians who, as you approach their neat and thriving village, come forth to welcome you as brethren, were but lately in no respect superior to the roving and savage hordes whose territory you have just left. A few short years ago, there was not among them, more than among the neighbouring tribes, any trace of civilisation, any sound of children busy at school, any spectacle of cultivated fields and smiling hamlets. Why is it now so different? Why, but because the Gospel has come down like rain on the desert, and caused it to bring forth and bud!

Another effect is a benign change in the usages of War. The Roman Empire, which ruled the world at the time of Christ's advent, was a very Moloch in war, an aggressive and ferocious Power, a strong and terrible Beast — as Daniel foresaw it in his vision—" with great iron teeth wherewith to devour and break in pieces." The temple of Janus, always open in time of war, was shut only thrice—and shut but for brief intervals—during the long period of seven hundred years. Scipio Africanus, who took Carthage, not only set that great metropolis on fire, but allowed it to burn seventeen days in sight of his Roman legions, and crowned the atrocity by selling as slaves 700,000 of the inhabitants. Even Titus Vespasian—whom the Roman historians denominate " the darling of mankind," on account of his mildness—massacred during his war with the Jews a million and a half of that ill-fated people, besides suffering 11,000 more to die of hunger. But no sooner did the imperial eagle bow before the cross of Christ than all such barbarities terminated. The first Christian emperor, Constantine, set the example of sparing prisoners taken in war, and accepting a ransom for their lives; and every subsequent age has witnessed a constantly growing desire and endeavour to mitigate the horrors of war. During last century, the gallant general who defended Gibraltar received the thanks of the British Parliament for his humanity to the enemy; and in our day there is nowhere to be found a more humane class of men than those who lead our fleets and armies to battle. Heathens and Mohammedans—Indian sepoys and Chinese mandarins—may still plan and perpetrate cold-blooded massacres; but in Christian countries nothing would now provoke a hotter outburst of public indignation than a needless effusion of human blood.

How much, again, has the Gospel done for the cause of civil liberty! Wherever it has been received in its purity, the people have become free; security of person and of property has been established; and a way opened to every man to rise, through his virtue and industry, to wealth and station. Was it so even in the most enlightened states and cities of antiquity? Was it so in Athens when that city, though far ahead of all the world in literature and art, had its 400,000 slaves, and only 30,000 freemen? Was it so in Rome when, even in the palmiest days of the empire, the rulers were afraid to give a separate and distinguishing dress to the slaves, lest it should be seen how few the freemen were? Or is it so even now in any Heathen or Mohammedan country—ay, or in any country where a corrupt form of Christianity prevails? The only free countries in the world are Christian countries; and the freest countries are those which are most purely Christian.

Equally beneficial has been the influence of the Gospel upon the administration of justice. In ancient Greece and Rome, the courts of law were a continual scene of open, undisguised iniquity. No suitor had the least chance of success, who was without the means either of bribing or of intimidating the judges. But in what Christian land is such a thing heard of as an attempt to tamper with the public administrators of the law? An unrighteous judge would be instantly crushed by public opinion. So entirely spotless and above suspicion is the integrity of those who occupy our seats of judgment, that no man hesitates to peril all he has, even to his life, upon their decision.

Another example is furnished by the marriage-relation. Prior to the advent of Christ, God's ordinance of holy wedlock had suffered awful perversion. Polygamy and arbitrary divorce preyed everywhere upon the vitals of society. Women were degraded from their rightful position of helps meet for man into that of mere slaves and drudges; and all the domestic relations were completely disorganized. But the Gospel brought and applied a remedy. Affirming marriage to be a Divine institution—defining it to be the union of two persons in wedlock, and only two, and inscribing on every nuptial altar the solemn words, "Whom God hath joined together, let not man put asunder"—it introduced and achieved a moral reformation which is perhaps without a parallel in the social benefits it has conferred on the world.

A final example may be taken from the influence of the Gospel on the cause of *charity.* In ancient Heathendom practical beneficence was all but unknown. Among the Greeks and Romans there was no provision for the poor; or, if a gratuitous distribution of corn was sometimes made in the great towns, it was only a concession for political purposes or a bribe to voters. And still more careless was ancient civilisation of the worse evils of disease, ignorance, and vice. Among all the splendid remains of ancient architecture,—amphitheatres, temples, palaces, triumphal arches,—there is nowhere to be found the ruins of an hospital or other benevolent asylum. It was left to the Gospel of Christ to set itself directly, and with all the sanctions of heaven, to the blessed task of abating poverty, healing disease, enlightening ignorance, and opening to the wretched the gates of mercy; and it is only *in Christian lands that* Philanthropy is an express vocation and pursuit. A Howard and a Wilberforce could never have lived but for the Gospel. And all experience shows that it is just in the proportion in which men are true Christians that they are abundant and self-sacrificing in their charities.

Such is a sample of the ascertained effects of the Gospel. What an inestimable boon must it be to our race, when even those effects of it which are open to the observation of the Historian are so signally beneficial! Happy day for the world when its influence shall be universally felt! Who would not labour to hasten that blessed era? Who would not with all his heart exclaim—

"Roll round, ye circling years, and speed it on?"

THE CLOUD'S SILVER LINING.

SAY, when in pity ye have gazed
On the wreathed smoke afar,
That o'er some town, like mist upraised,
Hung hiding sun and star,
Then as ye turned your weary eye
To the green earth and open sky,
Were ye not fain to doubt how Faith could dwell
Amid that dreary glare, in this world's citadel?

But Love's a flower that will not die
For lack of leafy screen,
And Christian Hope can cheer the eye
That ne'er saw vernal green;
Then be ye sure that Love can bless
Even in this crowded loneliness,
Where ever-moving myriads seem to say,
Go—thou art nought to us, nor we to thee—away!

There are, in this loud stunning tide
Of human care and crime,
With whom the melodies abide
Of the everlasting chime;
Who carry music in their heart
Through dusky lane and wrangling mart,

Plying their daily task with busier feet,
Because their secret souls a holy strain repeat.

Faith, Hope, and Love shed heavenly light
On Mammon's gloomiest cells,
As on some city's cheerless night
The tide of sunrise swells,
Till tower, and dome, and bridge-way proud
Are mantled with a golden cloud,
And to wise hearts this certain hope is given,—
"No mist that man may raise, shall hide the eye of Heaven."

KEBLE.

ELEMENTARY BODIES.

ALL the materials which compose the earth, the sea, the air, and the various organized beings that inhabit them, are of a compound nature,—that is, made up of two or more substances combined together; and even these latter substances are often themselves compound bodies, capable of being resolved into simpler ones. Thus, a piece of marble may be decomposed into two other substances,—lime and carbonic acid. Both lime and carbonic acid are in their turn susceptible of decomposition,—the former into calcium and oxygen, the latter into carbon and oxygen. These last-mentioned bodies, however—calcium, carbon, and oxygen—have hitherto resisted all attempts to resolve them into simpler forms of matter; and hence they fall to be regarded as *elementary* substances.

The exact number of elements or elementary bodies has not yet been fully ascertained. Many substances which the early chemists supposed to be simple or uncompounded, have been decomposed by later chemists. And it is far from improbable that hereafter, by new or improved methods of research, many of the substances which now figure as elements may be shown to be compounds.

The elementary bodies at present recognised amount to sixty-three in number, and are divided by chemists into two classes—namely, *metals* and *non-metallic substances;*—*fifty belonging to the* former class, and only thirteen to the latter.* Several of these bodies, however, possess properties which render it difficult to decide in which class to place them. Indeed, the distinction between metals and non-metallic substances, although convenient for the purposes of description, is to a great extent arbitrary—the two classes here and there graduating into each other.

Only a few of these elementary bodies enter *largely* into the composition of the globe. Of these the most abundant, and therefore the most important to be known, are—*oxygen*, *hydrogen*, *nitrogen*, *carbon*, *sulphur*, *phosphorus*, and *silicon.*

Oxygen is the most abundant substance in nature, forming more than one-fifth of the bulk of the atmosphere, eight-ninths of the sea and other waters, and fully one-third of the solid crust of the earth. In its free or uncombined state, it is a colourless, tasteless, and inodorous gas, a little heavier, bulk for bulk, than common air; but it is nowhere found free except in the atmosphere, where, however, it is always mixed (not combined) with another gas, *nitrogen.* It possesses a wonderful power of entering into combination with other substances of all classes; and its affinities, while almost boundless in their range, are at the same time so intense, that it can be procured in a pure state only from a comparatively small number of its compounds. It is essentially necessary to respiration and animal life, and it has also

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* List of the Elementary Bodies.

Non-metallic.
Boron
Bromine
Carbon
Chlorine
Fluorine
Hydrogen
Iodine
Nitrogen
Oxygen
Phosphorus
Selenium
Silicon
Sulphur

Metals.
Aluminum
Antimony
Arsenic
Barium
Bismuth
Cadmium
Cæsium
Calcium
Cerium
Chromium
Cobalt
Copper
Didymium
Erbium
Glucinum
Gold
Indium
Iridium
Iron
Lanthanium
Lead
Lithium
Magnesium
Manganese
Mercury
Molybdenum
Nickel
Niobium
Osmium
Palladium
Platinum
Potassium
Rhodium
Rubidium
Ruthenium
Silver
Sodium
Strontium
Tantalum
Tellurium
Thallium
Thorinum
Tin
Titanium
Tungsten
Uranium
Vanadium
Yttrium
Zinc
Zirconium

the striking property of supporting *combustion*, or burning. A lighted taper plunged into a bottle of oxygen gas burns with greatly increased brightness; and if the taper be blown out, and again introduced while the wick remains red-hot, it is instantly rekindled. The power which common air possesses of supporting respiration and combustion is entirely dependent on the oxygen it contains.

Hydrogen is, like oxygen, a colourless, tasteless, and inodorous gas. It is the lightest substance known, being sixteen times lighter than oxygen, and fourteen times lighter than air; on which account it is used for the inflation of balloons. Though unfit for respiration, it is not poisonous, for when mixed with air it may be inhaled without any deleterious effects. Though incapable of supporting combustion, it is exceedingly combustible, and when set on fire, burns with a pale yellowish flame, giving much heat but little light. It is very rarely met with in nature in a free state; but, in combination with oxygen, it constitutes one-ninth part by weight of water; and, united with carbon and oxygen, it enters largely into the composition of all animal and vegetable substances. If pure hydrogen and oxygen gas be mixed together, they remain unaltered; but if a lighted taper be brought into contact with the mixture, it explodes with violence; and if the two gaseous bodies have been mixed in the proportion of 1 part by weight of hydrogen and 8 parts of oxygen, the whole is condensed into water. Hence the origin of the name *hydrogen*, which literally signifies *water-producer*.

Nitrogen, called also *azote*, is slightly lighter than air. Its chief property is the negative one of being unable to support either combustion or animal life. A lighted taper plunged into it is immediately extinguished; and an animal, when immersed in it, instantly dies,—these results being due, not to any poisonous qualities in the gas, but simply to the absence of oxygen. Unlike oxygen and hydrogen, nitrogen exists in nature chiefly in a free state, and its main location is the atmosphere, where, mixed with oxygen, it serves the important purpose of diluting that gas, so as to moderate its activity, and fit it for the proper maintenance of combustion and life.

Carbon surpasses all other elements in its powers of combination, and in the variety of compounds into which it enters. Its inorganic compounds, indeed, are few in number; but in all vegetables and animals it is abundant, being apparently quite essential to the formation of organized structures. There are only two known substances in which carbon exists in a pure state. That beautiful gem, the *diamond*, consists of pure carbon in the crystallized condition; and the mineral called *graphite*, of which blacklead pencils are made, is also composed of carbon, but less pure. *Charcoal*, whether obtained from vegetable or from animal substances, is another form of carbon.

Sulphur, vulgarly called *brimstone*, is a brittle, crystalline solid, of a pale yellow colour, without taste or smell, and twice as heavy as water. It has very singular properties When heated up to a certain point, it melts, forming a mobile liquid which can easily be poured from one vessel to another; on a further elevation of temperature, it becomes thick and viscid; at a still higher heat, it becomes again a mobile liquid; and when the heat rises to a very high degree, it boils, and passes off in vapour. Nor is this all. If it be poured into water, when it has reached its liquid state, it immediately solidifies to a hard, brittle, yellow mass, similar to what it was previous to melting; but if, when heated to nearly its boiling point, it be poured into water, it is transformed into a transparent brown substance, which can be moulded by the fingers, or drawn out into thread.

Phosphorus is a soft, semi-transparent solid, slightly heavier than water, and not unlike wax in appearance. It is never found in nature in a free state; but, combined with oxygen, it forms one of the principal constituents of the bones of animals, and one of the ingredients of a fertile soil. It *is easily* melted and exceedingly inflammable.

When exposed to the air, it emits a whitish smoke, which is luminous in the dark, and smells like garlic. At a temperature far below that of boiling water, it takes fire and burns with a large brilliant flame, producing a cloud of white smoke. A blow, a hard rub, or even the heat of the hand is sufficient to kindle it, when it runs about in a melted and blazing state, causing burns which are very difficult to heal: it should, therefore, never be handled except under water. It is a violent poison.

Silicon or *Silicium* is a brownish-coloured solid. It is nowhere met with in a free state; but in combination with oxygen (when it is called *silica*), it is one of the most widely-diffused bodies in nature, entering largely into the composition of most of the rocks and mineral masses which form the crust of our globe. Sand, flint, rock-crystal, agate, opal, and chalcedony, are almost pure silica. It is also found, though in smaller quantities, in all kinds of water.

All the elements just described belong to the *non-metallic* class. Of the *metals* it may here suffice to say, that they are distinguished from the non-metallic bodies by their being conductors of heat and electricity, and by their possessing a peculiar lustre. *Abridged from* FOWNES.

COMBUSTION.

No chemical action is of more frequent occurrence than the combination of some other substance with oxygen. Frequently this combination takes place slowly, and quietly, and without any outward manifestation; but frequently also the process, from the energy of the affinities, is attended with heat and light; and then it receives the name of *combustion*, while the body which unites with the oxygen is called a *combustible*.

As the oxygen of the atmosphere is diluted with four times its bulk of nitrogen, the process of combustion cannot go on in atmospheric air so rapidly and vividly as in pure oxygen. But, as we all know, it does go on even in air; and since the most common combustibles, such as wood and coal, consist of carbon chiefly, or of carbon conjoined with hydrogen, all ordinary cases of combustion can be nothing but rapid and violent combinations of carbon and hydrogen with the free oxygen of the air. The heat must be referred to the rapidity of chemical union, and the light to the elevated temperature.

The amount of heat and light evolved, being thus dependent on the intensity of the chemical action—or, in other words, on the rapidity with which the combustible body and the oxygen of the air are brought into union—it follows that, if we would increase the heat, we must effect a more rapid introduction of air into the fuel or burning mass. It is in order to raise the heat to the point necessary to melt metal and other refractory substances, that air is forced into the fire by bellows or blowing machines in the blast furnace of the iron-worker, or drawn through the burning materials by the help of a tall chimney, the fireplace being closed on all sides, and no entrance of air allowed save between the bars of the grate.

It was long held that combustion could not take place without the presence of oxygen. But subsequent experience has shown that, although all combustions in our atmosphere, or in oxygen gas, depend on the presence of oxygen, the phenomenon of combustion is nothing more or less than chemical combination, attended by heat and light. Many examples, accordingly, can be adduced of combustion without oxygen; as, for instance, the case of iron and sulphur, which, when heated, combine with much heat and light. Although, therefore, oxygen is concerned in all ordinary combustions—that is, in all which take place in our atmosphere—the student must bear in mind the true definition of combustion, namely, "chemical combination, attended with heat and light."

Oxygen is usually termed a supporter of combustion, as distinguished from a combustible body, such as phosphorus. But we are not to suppose that the oxygen has any greater, or *any other share* in combustion than the phosphorus has.

It so happens that the oxygen is a gas, and the phosphorus a solid: the heat and light, therefore, *appear* to proceed from the phosphorus only. But, in reality, both bodies are equally concerned in the production of the heat and light; and while we may call phosphorus a supporter of combustion as well as oxygen, we may call oxygen a combustible as well as phosphorus. GREGORY.

COMPOUND BODIES AND THEIR NOMENCLATURE.

COMPOUND bodies are quite different in their appearance and properties from the elements of which they are made up. This difference is owing to the action of the chemical force, which is distinguished from the other physical forces by its power of changing the character and qualities of the materials on which it acts. *Gravitation* produces no essential change on bodies;—the falling leaf undergoes no alteration in its descent to the ground. *Heat* is equally powerless in this respect; for ice, when melted, yields back water with its original properties unimpaired, and steam, when condensed, is also pure water. Even *electricity*, except when it has previously excited chemical action, works no essential change;—the fragments of stone split off from a church-tower by a stroke of lightning retain all the properties of the mass from which they have been severed. But *chemical affinity* is always a transforming force. And very wonderful are many of the transformations which it effects. Thus, chlorine and sodium — the one a suffocating gas destructive of animal life, and the other a combustible metal equally noxious—form by their combination that wholesome condiment, common salt (*chloride of sodium*); while, on the other hand, the two elements, oxygen and nitrogen, which compose the healthful air we breathe, produce, when chemically united, that deadly poison, aquafortis (*nitric acid*).

In order to distinguish compound bodies from one another, as well as to indicate their composition, chemists have framed *a systematic nomenclature*, which, although somewhat complex, answers its purpose so well that it is fast superseding the arbitrary and fanciful names long given to these bodies. Most of the Binary compounds—that is, compounds made up of two elementary bodies—are, in the language of chemistry, either *bases* or *acids*. A base of which oxygen forms a part is called an *oxide*. Thus, a compound of copper with oxygen is named an *oxide of copper;* a compound of zinc with oxygen, an *oxide of zinc*. Frequently, however, the same elements form more than one oxide; and then Greek and Latin prefixes are employed to distinguish them. Thus, *protoxide of manganese* signifies the *first* oxide of manganese,—that is, the oxide containing the least amount of oxygen; *binoxide* signifies the *second* oxide; *peroxide*, the oxide containing the largest proportion of oxygen.

An acid of which ogygen forms a part is called by the name of the element with which the oxygen is united, with the addition of the terminal syllable *ic*. Thus, carbon combined with oxygen is named *carbonic acid;* sulphur combined with oxygen, *sulphuric acid*. And as the same elements often form more than one acid, it is usual to restrict the termination *ic* to the acid containing most oxygen, and to apply to the one containing the lesser quantity the termination *ous*. Thus, we have *nitrous* acid and *sulphurous* acid—each containing a smaller proportion of oxygen than is found in *nitric* and *sulphuric* acid. Acids which do not contain oxygen, but sulphur or hydrogen instead, are distinguished by the prefixes *sulpho* or *sulph*, and *hydro* or *hydr*. Thus, the acid composed of sulphur and arsenic is named *sulph-arsenic* acid; the acid composed of hydrogen and chlorine, *hydro-chloric* acid. The affixes *ic* and *ous* are also applied to these acids, in exactly the same manner as to the oxygen acids.

Those binary compounds which are neither bases nor acids receive names which terminate in *ide* or *uret*. Thus, the compounds of chlorine are termed *chlorides*, and those of sulphur, *sulphides* or *sulphurets*. There are, however, some exceptions to this rule; for example, the compounds of carbon and of sulphur with hydrogen, are usually named *carburetted hydrogen* and *sulphuretted* hydrogen.

The nomenclature of *salts*—bodies compounded of a base and an acid—is very simple. The name of the base is always given, and there is prefixed to it the name of the acid, with only a change in the terminal syllable. If the name of the acid terminates in *ic*, that of the salt is made to end in *ate;* if the name of the acid terminates in *ous*, that of the saline compound ends in *ite.* Thus, the salt formed by the union of sulphuric acid with potash is termed *sulphate of potash;* that formed by the union of sulphurous acid with soda, *sulphite of soda.* *Compiled.*

COMPOUND BODIES CONTINUED.

COMPOUND bodies are far too numerous to be here described in detail. But a brief account of three or four of the chief binary compounds may furnish some general idea of their properties and uses.

Of the *oxides*, the most abundant and valuable is *Protoxide of hydrogen*, or water. For the discovery of the composition of water we are indebted to Cavendish and Watt, who seem to have made it, unknown to each other, about the year 1781; and from their experiments, as well as those of later chemists, it appears that pure water consists by weight of 8 parts oxygen and 1 part hydrogen, and by measure of 1 part of the former and 2 parts of the latter. Water never occurs in nature in a state of perfect purity. Even rain-water, the purest of all, contains small quantities of extraneous matter; and the water of springs and rivers is still more impure, owing to the soluble substances which it takes up while percolating through the earth. Sometimes these latter are so abundantly absorbed that the water acquires a strong taste and active medicinal properties—as, for example, in what are called mineral springs. Water obtained from wells sunk near human habitations is generally contaminated with putrefying organic substances, which render it injurious to health if used for domestic purposes;—whence it follows, that water for the supply of towns should be brought from a considerable distance, and from places where it cannot be made impure by such noxious materials. Simple filtration through a porous stone or a bed of sand will separate suspended impurities; but distillation alone will free the liquid from impurities that are dissolved in it.

One of the distinguishing properties of water is its solvent power, which far exceeds that of any liquid known. Most salts are soluble in it; and, except in the case of common salt, which is equally soluble at all temperatures, their solubility usually increases with the temperature, so that a hot saturated solution deposits crystals on cooling. Most gases, too, are dissolved by water, though in very unequal quantities; but, by a law the reverse of that of saline solution, the colder the water, the more gas does it dissolve.

A still more remarkable property of water is, that it does not, like other fluids, contract in freezing, but, on the contrary, expands. Water-pipes often burst in frosty weather, owing to the expansive force of the freezing water; and ice, as every one knows, swims upon the surface of water, which it could not do if it were not lighter, and therefore more expanded, than it was in its previous liquid state. Nay, water begins to dilate before it actually freezes. It obeys the usual law till it has cooled down to the temperature of 40° (32° being the freezing point); but after that the abstraction of heat produces an increase instead of a diminution of volume. This expansion is usually attributed to the new and peculiar arrangement of its particles which takes place when water is freezing; for ice is in reality crystallized water, and during its formation the particles arrange themselves in ranks and lines, which cross each other, and consequently occupy more space than when they were in a liquid state. But, whatever be the chemical cause, the *final cause* is obvious. Had the case been otherwise,—had water, when deprived of a portion of its heat, become, like other bodies, specifically heavier than it was before—the present constitution of nature would have been deranged, and animal life endangered. At whatever time the temperature of the atmosphere became reduced to the freezing point, the water on the surface of our rivers and lakes would have been converted into a layer of ice; this layer would have sunk to the bottom as it froze; another layer of ice would have been immediately produced on the surface, which would also have sunk as it froze; then a third layer would have been formed, to sink also in its turn; and so on, in succession, till, in the course of time, all our rivers, from the surface to the bottom, would have been converted into solid masses of ice, which all the heat of summer could never have melted. But, in the existing constitution of things, all such dismal effects are prevented by the simple provision of the All-Wise and beneficent Creator that water should expand in freezing; so that the ice may swim upon the surface and prevent the cold from penetrating to any great depth in the fluid underneath.

Few of the *acids* are more abundant or serve more important uses in nature than *Carbonic acid.* Its constituents are carbon and oxygen, in the proportion by weight of 6 parts carbon to 16 oxygen. In its normal state it is a colourless and transparent gas, about one-half heavier than air, with a sweet taste and a slightly pungent odour; but, when exposed to great pressure, it becomes liquid, and when the liquid is exposed to the air it evaporates with great rapidity, causing such intense cold that it is converted into a white porous mass like snow. It is always present in the atmosphere to an amount which, though small relatively to the whole atmospheric volume, is absolutely great, and fully adequate, as experience shows, to its designed purpose of supplying carbon to plants. In union with lime, it composes 44 per cent. of the weight of limestone, chalk, and marble. It is emitted by animals in respiration, and it is constantly generated in the combustion of fuel, in fermentation, and in the decomposition of organic matter. Water, when charged with this gas by pressure, acquires a pleasant acidulous taste, and the gas, on the pressure being removed, effervesces and escapes in the manner which we witness on opening a bottle of soda-water. Indeed, the agreeable pungency of beer, porter, cider, etc., is, in a great measure, owing to the presence of carbonic acid; and, after it escapes, these beverages become stale and vapid.

Carbonic acid cannot support combustion. Though diluted with three times its volume of air, it extinguishes a light. And it is equally hurtful to animal life: it instantly suffocates any animal that may be immersed in it; and even when mixed with a large quantity of air, it acts as a narcotic poison, producing stupor and death. Hence the danger of crowding together many individuals in houses or ships without efficient means for removing the carbonic acid which is constantly disengaged during the process of respiration. Being much heavier than air, carbonic acid frequently accumulates at the bottom of wells, mines, and brewers' vats, occasioning death to persons incautiously venturing into them. Yet, strange to say, this carbonic acid, so fatal to animals, is highly salubrious to plants, which, indeed, subsist upon it, absorbing it from the air, and decomposing it by their leaves in such a manner as to retain the carbon and expel the oxygen,—a wonderful process which we can admire, but can neither understand nor imitate.

Chloride of lime—the *bleaching powder* of commerce—deserves to be noticed chiefly because of its services to the manufacturer. The *chlorine*, which forms its distinctive ingredient, has the singular property of destroying all colours of vegetable and animal origin; and by means of certain chemical processes the manufacturer is enabled to disengage the chlorine from the chloride, and then apply it to the purpose of whitening linen, cotton, and the rags used in the manufacture of paper. This is one of the many instances which demonstrate the practical value of the science of chemistry. "A number of years ago, extensive tracts of land in Lancashire were covered, as with a carpet, by thousands of yards of calico. These were the *bleaching grounds* on which cotton cloth—gray and dirty-looking as it came from the loom—was spread out to the sunlight, and carefully watered for months in order to whiten it. Good meadow land alone was suited to this operation; and thus thousands of acres of the richest pasturage were rendered useless for the purpose of agriculture. This waste of fertile land, and laborious spreading out and watering of calicoes, has been entirely superseded by the simple and cheap application of chloride of lime, by which the whole operation can be completed in a small building in forty-eight hours." Chloride of lime is also of great use as a disinfectant, or purifier of an offensive or infectious atmosphere. If a solution of it be exposed in shallow vessels, or if cloths steeped in it be suspended in the apartment, the carbonic acid of the air slowly decomposes it, and disengages the chlorine.

Carburetted hydrogen is also of great industrial value. It is often formed naturally. If the mud of a stagnant reedy pool be stirred, bubbles of gas will be observed rising to the surface, which take fire on the application of a light, and burn with a bright flame. This bubbling gas is carburetted hydrogen. Beds of coal often disengage this gas on being pierced, or on becoming cracked. It is owing to a large admixture of this gas that the air of coal-mines becomes explosive; so as to take fire from the miner's candle, causing the death of the unfortunate workmen. For industrial purposes this gas is procured artificially, chiefly from coal, which yields it in sufficient abundance to supply us with the means of lighting our streets and houses. To this end the coal is exposed to heat in large iron retorts; the gas thus obtained from the coal is then cooled, to separate the tar and other substances formed at the same time; and, being further purified by passing through a mixture of lime and water, it is received into immense iron vessels suspended in tanks of water, where it remains till wanted. From these gas-holders it is carried by suitable pipes to the street lamps and into the houses where it is burned. *Compiled.*

LAWS OF ELEMENTARY COMBINATION.

Of the sixty-two elementary substances known to chemists, only a very small number enter, to any large extent, into the constitution of nature. Oxygen is by far the most abundant substance. United with hydrogen, it constitutes water; mixed with nitrogen and a small proportion of carbon, it makes common air; while it enters, at the same time, largely into every kind of rock in the crust of the earth. Carbon, again, is the main constituent of all vegetable and animal matter; and silicon, in nearly equal combination with oxygen—when it makes silica—forms the basis of about half the rocks of the earth. We can thus trace back to a few simple substances all the multiform diversity of nature. How marvellous to reflect that the solid earth, the compact rocks, the limpid stream, and the clear atmosphere, with all the vegetable and animal tribes, are only the varied combinations of a few elementary ingredients!

The wonder increases when we find that these elementary ingredients everywhere combine only in certain definite and unvarying proportions. Thus, water, however produced, always consists of oxygen and hydrogen, in the proportion of 8 parts of the former to 1 of the latter by weight. Chalk, whether formed by nature or by the chemist, contains 43·71 parts of carbonic acid and 56·29 parts of lime. The rust which is formed upon the surface of iron by the action of the atmosphere is as invariable in its composition as if it had been produced by the most accurate manipulator, being always 28 parts of iron and 12 parts of oxygen. Where, again, the same elements unite, as they often do to form different bodies, such combinations are always related as multiples. Thus, in the different compounds of nitrogen with oxygen, we find that with the same proportion of the former the latter unites only in the successive ratios of 8, 16, 24, 32, and 40. There are no intermediate compounds whatever. And this law is perfectly general. The relation of the numbers may not in every body be quite so simple as in the case mentioned; but an exact numerical relation is found to underlie all compounds. So, in the gaseous state, bodies only unite according to exact measures or volumes. The volumes are always either equal or multiples the one of the other, and any extra quantity that may be present is sure to be left over when combination ensues.

It is impossible to conceive anything more grandly simple than all this. By merely multiplying the proportion of one of the ingredients, the most diverse substances are produced from the same elements. Thus, in the combinations of oxygen with nitrogen, the several compounds possess the most different qualities—a definite increase of one of the ingredients making all the difference between a virulent poison and the breath of man's life. What an unerring providence and skill does this evince in the continual assortment of nature's elementary products? What power, save an almighty one, could, from the mere varying composition of the same few elements, produce such wondrous diversity of result?

Still what specially claims our notice is the numerical exactitude thus found to lie at the root of nature. In breaking up its rounded and beautiful forms, they are found to rest on the most strictly arithmetical basis. It is seen to be, literally, a scientific truth, that the "mountains are weighed in scales and the hills in a balance." As, in the mighty movements of the heavens, we have to deal with the most rigorous measurements; so, in the minute and hidden movements of matter, we have equally to deal with such measurements. The constitution of the humblest bodies on earth, no less than that of the celestial orbs and orbits, leaves us, in the last resort, face to face with numerical order.

Whence this order? Science has disclosed its character; what has science to say as to its explanation? It has expressed, under the name of chemical affinity, all that it has to say on the subject. As we have, in the wide region of space, gravitation drawing all bodies to common centres, and cohesion holding the masses of the different bodies together; so, says science, we have the force of chemical or elective attraction serving by its occult power to give determinate character to every kind of material creation. But science merely conceals its ignorance by such general expressions. The laws in question are simply the last reductions of its persevering research; and, so far from furnishing any adequate explanation of the phenomena, they imperatively claim themselves to be explained. It is only when we recognise in these general laws the operative modes of a Supreme Intelligence, that we can reach an adequate explanation of the order we everywhere find in nature. TULLOCH.

QUOTATIONS FROM WORDSWORTH.

MY heart leaps up when I behold
 A rainbow in the sky:
So was it when my life began;
So is it now I am a man;
So be it when I shall grow old,
 Or let me die!
The child is father of the man;
And I could wish my days to be
Bound each to each by natural piety.

THANKS to the human heart by which we live,
 Thanks to its tenderness, its joys, its fears,—
To me the meanest flower that lives can give
 Thoughts, that do often lie too deep for tears.

A PRIMROSE by a river's brim
A yellow primrose was to him,
 And it was nothing more.

THE swan on still Saint Mary's Lake
Floats double, swan and shadow!

THE swan uplifts his chest, and backwards flings
His neck, a varying arch, between his towering wings:
The eye that marks the gliding creature sees
How graceful pride can be, and how majestic ease.

A RUDE mass
Of native rock, left midway in the square
Of our small market-village, was the goal
Or centre of these sports; and when, returned
After long absence, thither I repaired,
Gone was the old gray stone, and, in its place,
A smart assembly-room usurped the ground
That had been ours. There let the fiddle scream,

And be ye happy! Yet, my friends! I know
That more than one of you will think with me
Of those soft starry nights, and that old Dame,
From whom the stone was named, who there had sate,
And watched her table with its huckster's wares
Assiduous, through the length of sixty years.

NATURE never did betray
The heart that loved her; 'tis her privilege,
Through all the years of this our life, to lead
From joy to joy; for she can so inform
The mind that is within us—so impress
With quietness and beauty, and so feed
With lofty thoughts—that neither evil tongues,
Rash judgments, nor the sneers of selfish men,
Nor greetings where no kindness is, nor all
The dreary intercourse of daily life,
Shall e'er prevail against us or disturb
Our cheerful faith, that all which we behold
Is full of blessings. Therefore let the moon
Shine on thee in thy solitary walk;
And let the misty mountain winds be free
To blow against thee: and, in after years,
When these wild ecstacies shall be matured
Into a sober pleasure—when thy mind
Shall be a mansion for all lovely forms,
Thy memory be as a dwelling-place
For all sweet sounds and harmonies—oh! then,
If solitude, or fear, or pain, or grief
Should be thy portion, with what healing thoughts
Of tender joy wilt thou remember me,
And these my exhortations!

Upon the Sight of a beautiful Picture.

PRAISED be the Art whose subtle power could stay
Yon cloud, and fix it in that glorious shape;
Nor would permit the thin smoke to escape,
Nor those bright sunbeams to forsake the day;
Which stopped that band of travellers on their way
Ere they were lost within the shady wood;
And showed the bark upon the glassy flood
For ever anchored in her sheltering bay!

Soul-soothing Art! whom Morning, Noontide, Even,
Do serve with all their changeful pageantry;
Thou, with ambition modest yet sublime,
Here, for the sight of mortal man, hast given
To one brief moment caught from fleeting time,
The appropriate calm of blest eternity!

SECTION IV.

THE GREAT MART.

We shall consider this world as a great mart of commerce, where fortune exposes to our view many commodities—riches, ease, fame, and knowledge. Everything is marked at a settled price. Our time, our labour, our ingenuity, are so much ready money which we are to lay out to the best advantage; and such is the force of well-regulated industry, that a steady and vigorous exertion of our faculties, directed to one end, will generally secure success.

Would you, for instance, be rich? Do you think that single point worth the sacrificing everything else to? You may then be rich. Thousands have become so from the lowest beginnings, by patient diligence, and attention to the minutest articles of profit and expense. But you must give up the pleasures of leisure and of a free unsuspicious temper. Those high and lofty notions of morals which you brought with you from the schools must be considerably lowered. You must learn to do hard, if not unjust things. You must shut your heart against the Muses, and be content to feed your understanding with plain household truths. In short, you must not attempt to enlarge your ideas, or polish your taste, or refine your sentiments, but must keep on in one beaten track, without turning aside to the right hand or to the left. "But I cannot submit to drudgery like this; I feel a spirit above it." 'Tis well: be above it then; only do not repine that you are not rich.

Is knowledge the pearl of price? That, too, may be purchased by steady application, and long solitary hours of study and reflection. Bestow these, and you shall be wise. "But," says the man of letters, "what a hardship is it that many an illiterate fellow who cannot construe the motto of the arms on his coach shall raise a fortune and make a figure, while I have little more than the common conveniences of life." But was it in order to raise a fortune that you consumed the sprightly hours of youth in study and retirement? was it to be rich that you grew pale over the midnight lamp? "What reward have I then for all my labours?" What reward! Have you not a soul well purged from vulgar prejudices, and able to comprehend the works of man,—of God; a cultivated mind, replenished with inexhaustible stores of entertainment and reflection; a perpetual spring of fresh ideas; and the conscious dignity of superior intelligence? What reward can you ask besides?

"But is it not some reproach upon the economy of Providence that such a one, who is a mean dirty fellow, should have amassed wealth enough to buy half a nation?" Not in the least; he made himself a mean dirty fellow for that very end. He has paid his health, his conscience, his liberty, for it; and will you envy him his bargain? will you hang your head and blush in his presence, because he outshines you in equipage and show? Lift up your brow with a noble confidence, and say to yourself, I have not these things, it is true, but it is because I have not desired them; it is because I possess something better.

The man whose tender sensibility of conscience makes him scrupulous and fearful of offending, is often heard to complain of the disadvantages he lies under in every path of worldly honour and profit. "Could I but get over some nice points, and conform to the practice and opinion of those about me, I might stand as fair a chance as others for dignities and preferments." And why can you not? What hinders you from discarding this troublesome scrupulosity of yours, which stands so grievously in your way? If it be a small thing to enjoy inward freedom from remorse and perturbation, and a genuine integrity, pure in the last recesses of the mind,—if you think these advantages an inadequate recompense for what you resign,—dismiss your scruples this instant, and be a slave-merchant, a parasite, or what you please. MRS BARBAULD.

THRENODIES.

BRING the rathe primrose that forsaken dies,
 The tufted crow-toe, and pale jessamine,
The white pink, and the pansy freaked with jet,
The glowing violet,
 The musk-rose, and the well-attired woodbine,
With cowslips wan that hang the pensive head,
 And every flower that sad embroidery wears:
Bid amaranthus all his beauty shed,
 And daffodillies fill their cups with tears,
To strew the laureate hearse where Lycid lies.
MILTON.

How loved, how honoured once, avails thee not,
To whom related, or by whom begot;
A heap of dust alone remains of thee,
'Tis all thou art, and all the proud shall be. POPE.

PERHAPS in this neglected spot is laid
 Some heart once pregnant with celestial fire;
Hands, that the rod of empire might have swayed,
 Or waked to ecstasy the living lyre:

But Knowledge to their eyes her ample page,
 Rich with the spoils of Time, did ne'er unroll;
Chill Penury repressed their noble rage,
 And froze the genial current of the soul.

Full many a gem of purest ray serene,
 The dark unfathomed caves of ocean bear:
Full many a flower is born to blush unseen,
 And waste its sweetness on the desert air.

Some village Hampden, that, with dauntless breast,
The little tyrant of his fields withstood;
Some mute inglorious Milton here may rest,
Some Cromwell, guiltless of his country's blood.

The applause of listening senates to command,
The threats of pain and ruin to despise,
To scatter plenty o'er a smiling land,
And read their history in a nation's eyes,

Their lot forbade; nor circumscribed alone,
Their growing virtues, but their crimes confined;
Forbade to wade through slaughter to a throne,
And shut the gates of Mercy on mankind,

The struggling pangs of conscious Truth to hide,
To quench the blushes of ingenuous Shame,
Or heap the shrine of Luxury and Pride
With incense kindled at the Muse's flame.

Far from the madding crowd's ignoble strife,
Their sober wishes never learned to stray;
Along the cool sequestered vale of life
They kept the noiseless tenor of their way.

Yet e'en these bones from insult to protect,
Some frail memorial still erected nigh,
With uncouth rhymes and shapeless sculpture decked,
Implores the passing tribute of a sigh.

For who, to dumb Forgetfulness a prey,
This pleasing anxious being e'er resigned,
Left the warm precincts of the cheerful day,
Nor cast one longing lingering look behind?

On some fond breast the parting soul relies,
Some pious drops the closing eye requires;
E'en from the tomb the voice of Nature cries;
E'en in our ashes live their wonted fires.

GRAY.

THEY grew in beauty, side by side,
They filled one home with glee;
Their graves are severed, far and wide,
By mount, and stream, and sea.

The same fond mother bent at night
O'er each fair sleeping brow;
She had each folded flower in sight,—
Where are those dreamers now?

One, 'midst the forests of the West,
By a dark stream is laid,—
The Indian knows his place of rest,
Far in the cedar shade.
The sea, the blue lone sea, hath one,
He lies where pearls lie deep:
He was the loved of all, yet none
O'er his low bed may weep.

One sleeps where southern vines are dressed
Above the noble slain:
He wrapt his colours round his breast,
On a blood-red field of Spain.
And one—o'er her the myrtle showers
Its leaves, by soft winds fanned;
She faded 'midst Italian flowers,—
The last of that bright band.

And parted thus they rest, who played
Beneath the same green tree;
Whose voices mingled as they prayed
Around one parent knee!
They that with smiles lit up the hall,
And cheered with song the hearth,—
Alas! for Love, if thou wert all,
And nought beyond, oh Earth!

MRS HEMANS.

CLASSIFICATION AND STRUCTURE OF ANIMALS.

ANIMALS, though nearly countless in number and exceedingly diversified in outward form, exhibit such order and system in their internal structure, that naturalists have been able to arrange and classify them all under four groups.

The lowest group has the name of *Radiata*—that is, *rayed*—and comprises all animals which have the parts of their bodies arranged or disposed like rays round a centre. *Star-fishes, jelly-fishes,* and sponges are familiar examples.

The group immediately above this is called *Articulata*—that is, *jointed*—and sometimes *Annulosa*—that is, *ringed*. It includes all animals which have their body and limbs divided into joints or rings. Spiders, insects, crabs, and worms belong to this group.

The next group—the *Mollusca*—comprehends all animals which have a soft and moist body covered with a skin or shell. The cuttle-fish, the snail, and the oyster may be named as examples.

The highest group is the *Vertebrata;* a name which sufficiently indicates that all animals which have a vertebral column, or in other words, a back-bone and a skull, belong to it. In this group, and at the head of it, is man.

The group *Vertebrata* presents a much greater variety of structure than any of the other groups; and it is accordingly divided into four classes—namely, *Mammalia*—that is, animals (such as quadrupeds, bats, seals, and whales) which produce *living* offspring, and nourish their young with milk supplied from their own bodies;—*Birds*—that is, animals which have their bodies clad with feathers;—*Amphibia*—that is, animals (such as reptiles and serpents) with cold blood, some of which, like the frogs, from their power of suspending respiration, are able to live either on the earth or in the water;—and *Fishes*—that is, animals which live in water, moving by *fins*, and breathing by *gills*.

To show the admirable structure of animals and the fine adaptation of their organs to the functions they have to perform, it is not necessary to describe these four groups and their subdivisions in detail. For this purpose a glance at three classes of animals—*Birds*, *Fishes*, and *Insects*—will be sufficient.

It must be evident to even the most cursory observer that the structure of *Birds* is wisely and wonderfully adapted to their condition and habits of life. To fit them for cleaving the air, their head is small, their bill wedge-shaped, their neck long and movable in all directions, their body sharp on the under-side and flat on the back, and their bones hollow and comparatively light. Their feathers form an *envelope for their* bodies, which combines the apparently incompatible properties of lightness and warmth; and they are, moreover, so disposed one above the other, and from the fore part backward, that they present the least possible resistance to the air; while the warmth of the body is further provided for by the short soft down which fills up all the vacant spaces between the shafts of the feathers.

Nor is this wise adaptation discernible only in the general structure of birds. It may be seen in every part of that structure, even the most minute. It may be seen in the supply of unctuous matter which is given for defending the feathers from the moisture of the atmosphere,—a supply which invariably accords with the necessities of the different species,—those birds having most that reside in the water or open air, and those that live principally under cover having a more scanty share.* It may be seen in the movable membrane which defends the eye from injury when passing through hedges and thickets,—a membrane which is semi-transparent, and which the bird can move at pleasure. It may be seen in the singular contrivance by which the bird is enabled to change the shape of the eye so as to see the insect that is within a few inches of it, and the bird of prey which is several miles distant. And it may be further seen in the air-vessels which are spread over the whole body, and which, by the constant supply of air which they receive from the lungs, prevent respiration from being stopped or interrupted even in the swiftest flight.

The structure of *Fishes* is not less admirably adapted to their element and mode of life than the structure of birds. Their shape, it cannot escape the most careless observer, is finely fitted to cleave their native deeps with the least possible resistance. The use of their fins and tail, too, is obvious; and their belly-fins cannot appear unnecessary, when it is recollected that their centre of gravity lies near the back, and that without some kind of feet they would float with their backs downward.

Not less adapted to their condition, as inhabitants of the water, are the *gills* and the *air-bladder*. The *gills*, placed on each side of the neck, are the organs by which they breathe. In this operation they fill their mouth with water, which they throw backward with so much force as to lift open the great flap, and force the water out behind; and in the passage of this water, all or at least the greater part of the air contained in it is left behind, and carried into the body to perform its part in the animal economy. The *air-bladder*, which lies in the abdomen, along the course of the backbone, enables them to increase or diminish their specific gravity, and thus sink or rise in the water. If they want to sink, they compress this bladder by means of their abdominal muscles; so that the bulk of their body is diminished. If they want to rise, they relax the pressure of the muscles, the air-bladder again acquires its natural size, the body is rendered more bulky, and they ascend towards the surface. Some fishes are destitute of air-bladders; but this is because they do not need any,—their *habitat* being at the bottom of the water.

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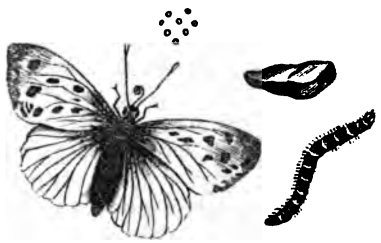
* This accounts for poultry, when wet, having a ruffled and uncomfortable appearance.

Insects are so denominated from their bodies appearing as if they were intersected or cut into pieces. They have three principal parts—the *head*, the *thorax*, and the *abdomen;* and they have also legs, wings, eyes, and *antennae* or instruments of touch.

Some insects proceed in nearly a perfect state from the egg; but the greater number undergo a *metamorphosis* at three different periods of their existence. From the eggs they come forth as *larvae*, grubs, or caterpillars. These consist of a long body, covered with a soft, tender skin, divided into segments or rings. In this larva state some of them remain for many months; and in this state they are, in general, exceedingly voracious, oftentimes devouring more than their own weight in the course of a day. As soon as their parts become perfected, they fix upon some convenient place for undergoing the change into what is called *pupa*, *aurelia*, or *chrysalis*. Some of them spin webs or cocoons, in which they enclose themselves; others wrap themselves up in leaves of vegetables; and many conceal themselves beneath the surface of the earth. Preparatory to the transformation, they cease to take any food; and when the change is at hand, many of them may be observed alternately extending and contracting their bodies, as if disengaging themselves from the caterpillar skin. In their *chrysalid* state they remain for some time apparently inanimate, though actually in possession of life; and as soon as they have acquired strength sufficient to break the bonds that surround them, they exert their power, and appear in their *imago* or *perfect* state. For a little time they continue humid and weak; but as the humidity evaporates, their wings and shell become hardened, and they soon afterwards commit themselves with safety to their new element.



"How surprising," says Messrs Kirby and Spence, "are the metamorphoses of the insect world! That butterfly, which amuses you with its aërial excursions, did not come into the world as you now behold it. At its first exclusion from the egg, and for some months afterwards, it was a worm-like caterpillar, crawling upon sixteen short legs, greedily devouring leaves with two jaws, and seeing by means of twelve eyes so minute as to be nearly inperceptible. You view it now furnished with wings capable of rapid and extensive flights; of its sixteen feet, ten have disappeared, and the remaining six are wholly unlike those to which they have succeeded; its jaws have vanished, and are replaced by a curled-up proboscis suited only for sipping liquid sweets; the form of its head is entirely changed; two long horns project from its upper surface; and instead of twelve invisible eyes, you behold two, very large, and composed of at least 20,000 convex lenses, each supposed to be a distinct and effective eye. Dissect the animal, and you will witness changes still more extraordinary. Nearly the whole *body of the* caterpillar was occupied by a capacious stomach; the butterfly has only an almost imperceptible thread-like viscus, while the abdomen is now filled by two large packets of eggs. In the former, two spirally-convoluted tubes were filled with a silky gum; in the latter, both tubes and silk have almost totally vanished. What a surprising transformation! Nor is this all. The change from one form to another was not direct: a state not less singular intervened. After casting its skin, even to its very jaws, several times, and attaining its full growth, the caterpillar attached itself to a leaf by a silken girth. Its body greatly contracted, its skin once more split asunder, and disclosed an oviform mass, without exterior mouth, eyes, or limbs, and exhibiting no other symptom of life than a slight motion when touched. In this state of torpor the insect existed for many months, until at length the tomb burst; and out of a case not more than an inch long, and a quarter of an inch in diameter, proceeded the butterfly before you, which covers a surface of nearly four inches square."

The same authors have drawn a beautiful analogy between the different states of insects and those of the human soul. The butterfly—the representative of the soul—is prepared in the *larva* for its future state of glory; and if it be not destroyed by the ichneumons and other enemies to which it is exposed,—symbolical of the sins which destroy the spiritual life of the soul,—it will come to its state of repose in the *aurelia*, which is its Hades; and at length, when it assumes the *imago*, which is its heavenly existence, break forth with new power and beauty to its final glory. *Compiled.*

THE ENGLISH LANGUAGE.

Our modern English is a composite tongue, formed by the intermixture of the languages of the various races that have successively inhabited the British Isles.

Britain appears to have been first peopled by the Celts, Cymry, or Britons, as they are variously styled; and the aboriginal language was consequently the Celtic, of which at least two dialects were in use—the Cymriac and the

Gaelic. This continued to be the national language until the invasion of Britain by the Romans under Julius Cæsar, when many of the ancient inhabitants were driven from the southern and central parts of the island to the fastnesses of the mountains in the west and north. To these mountain retreats the Celts carried their ancient tongue; and to this day their descendants in Wales and in the Highlands of Scotland still speak either Cymriac or Gaelic in comparative purity. On our modern speech, the aboriginal Celtic has exerted but slight influence. The names of places, indeed, all over Britain, are still to a great extent Celtic—having passed down almost unchanged from the time of the ancient Britons. But with this exception, there are few Celtic words in our modern English; and even those few—such as *cairn*, *cromlech*, *clan*—are mostly of recent transplantation.

During the long occupation of Britain by the Romans—an occupation which extended from 60 B.C. to A.D. 410—it might have been expected that the Latin tongue would have displaced or at least have greatly modified the aboriginal Celtic: and doubtless, had the Romans established themselves permanently in the island, and freely intermixed with the natives, the result would have been a race and language very different from what we now find in this country. In process of time there would have arisen a mixed population, combining the blood and qualities of both Roman and Celt; and the language of this *creole* race would have resembled the French or the Spanish; that is, it would have been a language similar to what are called the *Romanz* languages, all of which have sprung from the efforts of a rude Celtic or Gaulish nation to speak the Latin. But such a species of corrupt Latinity was not destined to become the language of Englishmen. The Romans removed from our island without leaving behind them almost any trace of their noble tongue; and though it be true that a very large portion of modern English is derived from the Latin, yet this element of our speech has not descended to us as a legacy from our Roman invaders, but is an importation of much later date.

Soon after the departure of the Romans, Britain was [illegible] jugated by two kindred tribes from the shores of the Baltic. These were the Angles and Saxons—Angles being probably the general name of the race or stock, of which the Saxons were only a branch. With this new race came a new language; and as this new race came not as mere sojourners like the Romans, but as permanent settlers, so their language soon displaced every other in at least the lowlands of the country, to which they gave the new name of *Angle-land* or *Engle-land.* The Anglo-Saxon tongue, thus introduced into Britain, belonged to the Gothic or Teutonic class of languages; and in its written form (of its spoken form we know nothing) it exhibited no small complexity of grammatical structure. It possessed its declensions, its cases, its numbers, and in particular its genders of nouns and adjectives, indicated by terminations as in Latin and Greek. To this fact the fragments of Anglo-Saxon literature which are still extant bear incontestable witness; and had the Anglo-Saxons continued to rule England, it is not improbable that our modern English, instead of being nearly uninflected and full of prepositions, would have been as regular in its forms, and as elaborate in its inflectional apparatus, as the Latin or the Greek. But the tongue of our Teutonic ancestors was not to retain its complex grammatical structure. After four centuries of undisputed possession of the country, the Anglo-Saxon social system began to decay, and the language to degenerate. The reign of Ethelred the Unready, which commenced in the year 975, was a succession of national calamities. A quarter of a century of subjection to the Danish invaders followed. The feeble reign of Edward the Confessor only served to make bad worse; and at last the conquest of England by the Normans gave the finishing stroke to Anglo-Saxondom, by subjecting almost all ranks and classes of the population to the yoke of slavery. When the political and social system of a nation is broken up—when the class possessing leisure and wealth and learning is reduced to poverty and subjection—when schools are closed, and the juvenile population left to grow up without any opportunity of learning to read and write their native tongue—it is impossible that the national language, especially if it be at all elaborate or artificial, can long retain its literary form and grammatical structure. Suppose all the schools of England were from this hour to be shut up—all English books burnt, all literary pursuits prohibited, the printing-press destroyed, and the great body of Englishmen reduced to serfdom—how soon would our language, as presently written and spoken by the upper and middle classes—the English of Addison and Macaulay—give place to the mere *patois* of our provincial towns or the rude vernacular of our country districts! Now this is substantially what befell the Anglo-Saxons at the Norman conquest. The higher and middle classes were compelled to forego their professional and literary pursuits: the class for whom Anglo-Saxon books had heretofore been written ceased to exist; and such books accordingly were no longer produced. The language became exclusively a *spoken* language; and, as an inevitable consequence, its complex inflectional structure fell to pieces.

The Norman conquest did not at first affect the language of our Anglo-Saxon ancestors otherwise than by aiding that process of disintegration which has just been described. But ultimately it exercised a mighty direct influence, by introducing a vast number of French words and idioms, or rather Latin words and idioms modified by French usage. The Normans, indeed, were not Frenchmen; they were Northmen or Scandinavians, substantially from the same parent stock as the Angles and Saxons. But during their residence in Normandy they had adopted the French tongue, or, more strictly, that branch of the Romanz language which then went by the name of Norman-French. And as their conquest of England was complete and their abode permanent, it was inevitable that their Norman-French should eventually mingle with the native Teutonic speech, and thus create a composite language.

When they first met, however, these two languages, like the two races that spoke them, were but little disposed to enter into alliance; nor was it until a mixture of the races took place, that a mixture of the languages commenced. For at least a century after the conquest, the Normans we[illegible] still looked upon as foreigners and enemies. Their intercourse with the native population was that, so to speak, of slaveholders with slaves; or if any advances towards a more friendly intercourse were made on the side of the Normans, these were repulsed or but coldly received by a people who still cherished the hope of ultimately expelling their spoilers. The coalescence of the two rival tongues cannot be said to have begun at an earlier date than the accession of Henry II., in 1154, who, having the blood of Alfred in his veins as well as that of the Normans, seems to have reconciled the Anglo-Saxons to his yoke by the illusion that they had got back the line of their ancient kings. But from that period onward the mingling of the two languages went on uninterruptedly,—the purely Teutonic form of speech gradually giving place to a compound of Teutonic and Romanz. In Chaucer, the father of our literature, we find the old English variegated by a considerable admixture of Norman-French; and in the writers who followed him we find a still larger proportion of this ingredient. Indeed, the increasing adoption of new words from the Norman-French, or, which is the same thing, from the Latin, appears to have been "a constitutional habit" of the language down to the middle of the sixteenth century, when modern English assumed a permanent crystallized form. Nor has this tendency altogether ceased even at the present day. It is still the practice of our language, when it has occasion for new words, to draw, not upon the original Teutonic tongue, but upon the Romanz or the Greek. Probably not a single word of Anglo-Saxon extraction has been added to our vocabulary since the Norman conquest; while many thousands have been adopted from the Romanz. Nay, multitudes of Anglo-Saxon words have been allowed to drop out of use and disappear; while the few French or Latin words which have died out, have been invariably replaced by words from the same quarter. It is now calculated that at least one-fifth of the Anglo-Saxon language has ceased to be used, and that of the words catalogued in our dictionaries nearly three-fourths are of foreign extraction.

The fact, however, that the Romanz ingredient preponderates over the Anglo-Saxon does not render it the less true that the latter is still the basis and regulative power of our language. It is evident that that element of a composite language must be the radical and fundamental one which contains the greatest number of vocables expressing the simpler ideas and most familiar objects. Now, all the simpler ideas and objects, whether natural or artificial, are expressed in English by words of Teutonic origin. Such, for instance, are the words, *man*, *woman*, *sun*, *moon*, *earth;* the names of the simpler colours, as *green*, *red*, *yellow*, *brown*, (*purple*—a compound colour—is derived from the Greek); the common acts of life, *to run*, *to fly*, *to eat*, *to sing*, etc.; the primary passions of our nature, *love*, *fear*, *hate*, etc.; the names of the ordinary animals, and their cries, as *horse*, *hound*, *sheep*, *to neigh*, *to bark*, *to bleat*, *to low*, etc.; the employments and ranks of life, *to speak*, *to read*, *to write*, *to walk*, *shepherd*, *ploughman*, *seaman*, *miller*, *earl*, *king*, *queen*, etc.; and the most generally known among artificial objects, as *ship*, *house*, *boat*, *door*. On the same principle, those religious objects and ideas which are of a simple and obvious character are represented by words of Teutonic extraction, while the more scientific and technical portion of the religious vocabulary, is almost, in every case, of Latin or Greek derivation. Thus, *God*, *fiend*, *hell*, *righteous*, *wicked*, *faith*, *hope*, are all pure Anglo-Saxon words; while *predestination*, *justification*, *sanctification*, *baptism*, etc., come from foreign sources. That most simple and unsophisticated of all embodiments of religious feeling—the Lord's prayer—contains only four words (*deliver*, *temptation*, *power*, *glory*) which are not of the Anglo-Saxon stock.

But a yet stronger evidence of the radical and regulative nature of the Anglo-Saxon ingredient is to be found in the fact that the grammar of our language is still throughout purely Anglo-Saxon or English. Little, indeed, now remains of its original inflexional system; but what remains is all of the original type; it has not been in the slightest degree Gallicized or Latinized. The French and Latin words which have been incorporated with the ancient tongue have been assimilated in grammatical structure to that ancient tongue. With all its accretions from the Celtic, the French, the Latin, the Greek, the language of Britain is still strictly the *English* language.

It has been computed by one of the highest authorities on the subject—Professor Craik of Belfast—that the words catalogued in our dictionaries (exclusive of the names of places, a few Danish and Indian words, and the continually increasing crowd of scientific terms formed from the Greek) amount altogether to about 50,000—15,000 being of Teutonic extraction, and 35,000 from the French or Latin; that of these 50,000 words, only 10,000 are employed in ordinary writing, and 5000 in colloquial intercourse; and that of the written words one-half may be Anglo-Saxon—of the spoken, three-fourths. In books, however, the proportions of Anglo-Saxon and Romanz greatly vary according to the nature of the subject and the taste of the author. In scientific and philosophical works, the Romanz ingredient predominates; in poems and works of fiction, the Anglo-Saxon. In the authorized version of the Bible, the Pilgrim's Progress, the writings of Defoe and Swift, the Anglo-Saxon preponderates; in the works of Johnson, Gibbon, and Robertson, the Romanz. For a happy combination of the two elements we may go to the essays of Addison, Goldsmith, and Macaulay. What sweet music the two can discourse when blended together by the hand of a master, we have ample evidence in the plays of Shakspeare, and in the poetry of Dryden, Shelley, and Tennyson. As an example of the force and even fiery energy with which the English tongue can utter itself, nothing can be named superior to the sermons of South. *Compiled.*

SPRINGS, RIVERS, AND LAKES.

Springs are little reservoirs or basins below the surface of the earth, from which water *springs* or issues. These reservoirs derive their supply of water from the rain, dew, and snow, which reach them by percolation through the soil and strata above them. Hence springs are most abundant in the sides and at the foot of hills; while in districts where there are no hills to attract and condense the aqueous vapours of the atmosphere, they are few in number and scantily supplied. When the reservoir is large, as compared with the outlet from which its water issues forth, the spring sends out water all the year without any diminution even in the driest weather; but when the reservoir is small as compared with the outlet, the spring becomes dry in hot seasons. If the reservoir is at a considerably higher elevation than the point where the water flows forth, the water springs up vertically or in opposition to the force of gravity; its upward flow being due to the well-known tendency of water to rise as high as its source. The phenomena of intermitting springs are supposed to be owing to the alternate rise and fall of the water in the reservoir: when that water is above the level of the outlet, the spring flows; when it is below the level of the outlet, the spring ceases to flow. Spring-water is harder than rain-water, because it holds in solution the various mineral substances which it has received in passing through the earth.

Rivers are formed by the confluence of brooks and small streams which have their source in springs that break out at the foot of a declivity, or on the side of some hill, or from a swamp. Small rivers unite to form a great river—being called its *tributaries*, *affluents*, or *feeders*. The country or district drained by a river is called its *basin;* the hollow in that basin along which it flows is called its *bed*. The solid land which bounds the bed is named its *banks;* and these banks are distinguished by the appellation of *right bank* or *left bank*, according as they are on the right or on the left hand of a person moving down the stream. A river frequently divides into a number of *arms* and *branches*, each of which runs to the sea,—some of the branches reuniting, and again detaching themselves from one another. This occurs in the case of the Danube, the Ganges, the Nile, etc. The land enclosed by the arms of a river is called its *delta*, from the Greek letter Δ, which almost all river deltas resemble in form. Most large rivers take their rise in mountainous districts or in elevated tabl[illegible] lands, and their course is more or less rapid according to the declivity of their beds and the quantity of water they contain.

Rivers which pass in their descent from rocks of one formation to those of another, often form *cascades* or *cataracts*. Nothing can be more picturesque than some of these waterfalls. Sometimes we see a body of water, before it arrives at the bottom, broken and dissipated into showers, as the Staubbach; sometimes it forms a watery arch, projected from a rampart of rock, under which the traveller may pass dry-shod, as the falling spring of Virginia; in one place we see it, as in the Rhine, urge on its foaming billows amongst pointed rocks; in another, we see it, as in the Czettina, rolling down from terrace to terrace, and presenting sometimes a sheet, and sometimes a wall of water. The most celebrated cataract in the world is the Falls of Niagara, where a broad deep river is precipitated from a height of about 160 feet. Some magnificent cascades have been formed, at least in part, by the hands of man, as the cascade of Velino, near Terni, which is attributed to Pope Clement VIII.

It is reckoned that in the old world there are about 430, and in the new world at least 145 rivers which fall *directly* into the sea. The largest river in Europe is the Wolga, which falls into the Caspian Sea, after a course of 2400 miles; the largest in Asia is the Yenisei in Siberia, whose course is about 2000 miles; the largest in Africa is the Nile, supposed to be about 3000 miles long; and the largest in America is the Amazon—the greatest river in the world—which, after a course of nearly 4000 miles, falls into the Atlantic with a body of water 180 miles in breadth.

Lakes are accumulations of water surrounded on all sides by the land, and having no direct communication with the sea. They are divided into, 1. Such as neither receive nor give out rivers; 2. Such as give out rivers without receiving any; 3. Such as receive without giving out rivers; and 4. Such as both receive and give out rivers. In the first kind, some are temporary, and depend on the fall of rain or the melting of snow for the supply of their waters; and others are perennial, deriving their supply from springs at the bottom. In the second description of lakes, the supply from springs is supposed to exceed the waste by evaporation, and the redundant quantity flows off by rivers. In the third kind of lakes, the water received by rivers must either be equal to the quantity carried off by evaporation, or the superabundant waters must have some subterraneous outlet. In such as receive and give out rivers, the quantity of water admitted, and the quantity carried off, are supposed nearly to balance each other. Some lakes or inland seas contain fresh water; others contain salt or brackish water. Those which give rise to rivers, or are formed in the course of rivers, are fresh; but such as receive rivers, and have no visible outlet, contain salt water. The largest lake in the world is the Caspian Sea in Asia; it has an area of 140,000 square miles, and is a collection of salt water. The largest fresh-water lake in the world is Lake Superior in North America; it is 1500 miles in circumference. *Compiled.*

THE FALLS OF NIAGARA.

THE thoughts are strange that crowd into my brain,
While I look upward to thee. It would seem
As if God poured thee from his "hollow hand,"
And hung his bow upon thine awful front,
And spoke in that loud voice, which seemed to him
Who dwelt in Patmos for his Saviour's sake,
"The sound of many waters;" and had bade
Thy flood to chronicle the ages back,
And notch His centuries in the eternal rocks.
Deep calleth unto deep. And what are we,
That hear the question of that voice sublime?
Oh! what are all the notes that ever rung
From war's vain trumpet, by thy thundering side!
Yea, what is all the riot man can make
In his short life, to thy unceasing roar!
And yet, bold Babbler! what art thou to Him,
Who drowned a world, and heaped the waters far
Above its loftiest mountains?—a light wave,
That breaks and whispers of its Maker's might!

BRAINARD.

THE CATARACT OF VELINO.

THE roar of waters!—from the headlong height
Velino cleaves the wave-worn precipice;
The fall of waters! rapid as the light
The flashing mass foams, shaking the abyss;
The hell of waters! where they howl and hiss,
And boil in endless torture; while the sweat
Of their great agony, wrung out from this
Their Phlegethon, curls round the rocks of jet
That gird the gulf around, in pitiless horror set,

And mounts in spray the skies, and thence again
Returns in an unceasing shower, which round,
With its unemptied cloud of gentle rain,
Is an eternal April to the ground,
Making it all one emerald:—how profound
The gulf! and how the giant element
From rock to rock leaps with delirious bound,
Crushing the cliffs, which, downward worn and rent
With his fierce footsteps, yield in chasms a fearful vent

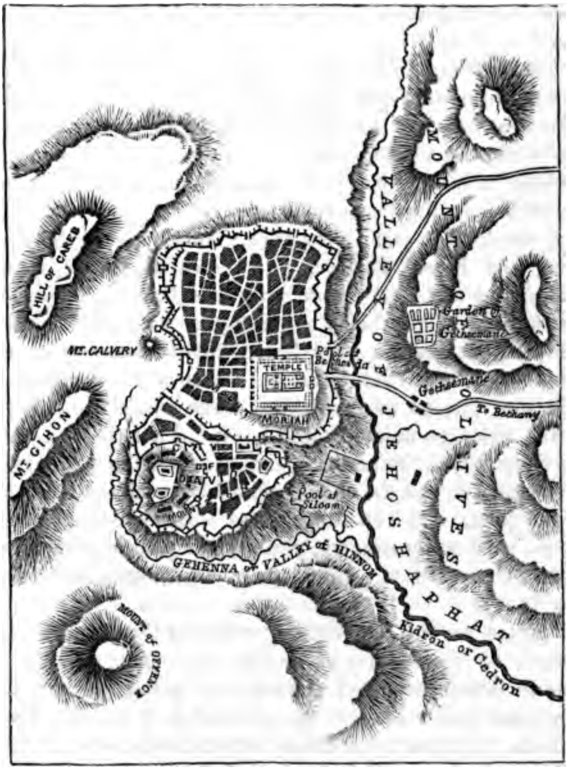
To the broad column which rolls on and shows
More like the fountain of an infant sea,
Torn from the womb of mountains by the throes
Of a new world, than only thus to be
Parent of rivers, which flow gushingly,
With many windings, through the vale:—Look back!
Lo! where it comes like an eternity,
As if to sweep down all things in its track,
Charming the eye with dread,—a matchless cataract,

Horribly beautiful! but on the verge,
From side to side, beneath the glittering morn,
An Iris sits, amidst the infernal surge,
Like Hope upon a deathbed, and, unworn
Its steady dyes, while all around is torn
By the distracted waters, bears serene
Its brilliant hues with all their beams unshorn:
Resembling, 'mid the torture of the scene,
Love watching Madness with unalterable mien.

BYRON.

JERUSALEM.

The modern city of Jerusalem may be roughly stated to be about a mile in length, and half a mile in breadth. Its population (excluding the pilgrims who visit it at Easter and other seasons) is about 12,000, of whom three-fourths are Mohammedans. It occupies two small hills, with valleys or ravines on three sides. On the east is the valley of Jehoshaphat; on the south, the valley of Siloam; and on the west, the valley of Rephaim. On the further side



of these valleys are the hills which command the city —namely, the Mount of Olives on the east; the Hill of Offence on the south; Mount Gihon on the west; and, on the north-west, Scopo, where Titus encamped; so that the Scripture representation of Jerusalem, as guarded by mountains, literally answers to its topographical situation:— "As the mountains are round about Jerusalem, so the Lord is round about his people, from henceforth, even for ever."

"When seen," says Chateaubriand, "from the Mount of Olives, Jerusalem presents an inclined plane, descending from west to east. An embattled wall, fortified with towers and a Gothic castle, encompasses the city all round; excluding, however, part of Mount Zion, which it formerly enclosed. In the western quarter, and in the centre of the city, the houses stand very close; but in the eastern part, along the brook Kedron, you perceive vacant spaces; among the rest, that which surrounds the mosque erected on the ruins of the Temple. The houses of Jerusalem are heavy square masses, very low, without chimneys or windows: they have flat terraces or domes on the top, and look like prisons or sepulchres. The whole would appear to the eye one uninterrupted level, did not the steeples of the churches, the minarets of the mosques, the summits of a few cypresses, and the clumps of nopals, break the uniformity of the plan. On beholding these stone buildings, encompassed by a stony country, you are ready to inquire if they are not the confused monuments of a cemetery in the midst of a desert.

"Enter the city, but nothing will you there find to make amends for the dulness of its exterior. You lose yourself among narrow, unpaved streets, here going up hill, there down, and you walk among clouds of dust or loose stones. Canvass stretched from house to house increases the gloom of this labyrinth. A few paltry shops expose nothing but wretchedness to view. Not a creature is to be seen in the streets, not a creature at the gates, except now and then a peasant gliding through the gloom, concealing under his garments the fruits of his labour, lest he should be robbed of his hard earnings by the rapacious soldier. The only noise heard from time to time in the city is the galloping of the steed of the desert; it is the janissary who brings the head of the Bedouin, or who returns from plundering the unhappy Fellah."

The Jerusalem of sacred history is no more. The very course of the walls is changed, and the boundaries of the ancient city are become doubtful. The monks pretend to show the sites of the sacred places; but neither Calvary nor the Holy Sepulchre, much less the Dolorous Way, the House of Caiaphas, etc., have the slightest pretensions to even a probable identity with the real places. A few gardens still remain on the sloping base of Mount Zion, watered from the pool of Siloam; the gardens of Gethsemane still show a sort of ruined cultivation; the Mount of Olives still retains a languishing verdure, and nourishes a few of the trees from which it derives its name; but all round about Jerusalem the general aspect is blighted and barren; the bare rock looks through the scanty sward; and the grain itself, like the staring progeny of famine, seems in doubt whether to come to maturity or die in the ear. The vine that was brought from Egypt is cut off from the midst of the land.

To conceive of its ancient aspect, we must endeavour to shut our eyes to the domes, and minarets, and castellated towers, which now revolt every pleasing and sacred association; we must forget the Turks, the Arabs, and the monks. We must imagine ourselves looking down from Mount Olivet on a well peopled and strongly fortified city, occupying the oblong area of two sloping hills, about four miles in circumference, and sheltered on almost every side by more commanding elevations, cultivated in terraces, and clothed to their very summits with the olive, the fig-tree, and the palm. The city itself, if it could not boast of a Parthenon, was probably equal, in architectural decoration, to any one then standing in the world. It could not, indeed, compare with Babylon, or Nineveh, or the hundred-gated metropolis of Egypt, either in extent or magnificence; but its two Temples—the one built by Solomon, and the other repaired and completed by Herod—were successively the admiration of the world. From the Temple the city had the appearance of an amphitheatre, the slope of the hill being just sufficient to present it to the greatest advantage. At certain distances, towers of not less strength than architectural beauty broke the line of the walls; while on the left, the acropolis of Zion overlooked the whole city. If to these topographical and political advantages we add the local sanctity which dignified the scene of so many proud historical recollections, and connect with the bulwarks, and palaces, and gardens of the metropolis of Judea, its consecrated character as the chosen mountain of Jehovah—the "city of God"—we shall obtain some idea of the aspect which it once presented, when the light of heaven, which nowhere comes with a purer ray, shone on a free and favoured people, and the voice of joy and thanksgiving was heard ascending from the dwellings of her citizens. CONDER.

JERUSALEM BEFORE THE SIEGE.

Titus. IT must be—
And yet it moves me, Romans! it confounds
The counsel of my firm philosophy,
That Ruin's merciless ploughshare must pass o'er,
And barren salt be sown on yon proud city.
As on our olive-crowned hill we stand,
Where Kedron at our feet its scanty waters
Distils from stone to stone with gentle motion,
As through a valley sacred to sweet peace,
How boldly doth it front us! how majestically,
Like a luxurious vineyard, the hillside
Is hung with marble fabrics, line o'er line,
Terrace o'er terrace, nearer still, and nearer
To the blue heavens! There bright and sumptuous palaces,
With cool and verdant gardens interspersed;
There towers of war that frown in massy strength;
While over all hangs the rich purple eve,
As conscious of its being her last farewell
Of light and glory to that fated city.
And, as our clouds of battle, dust, and smoke
Are melted into air, behold the Temple

In undisturbed and lone serenity,
Finding itself a solemn sanctuary
In the profound of heaven! It stands before us
A mount of snow, fretted with golden pinnacles!
The very sun, as though he worshipped there,
Lingers upon the gilded cedar roofs;
And down the long and branching porticos,
On every flowery-sculptured capital,
Glitters the homage of his parting beams.
By Hercules! the sight might almost win
The offended majesty of Rome to mercy. MILMAN.

LAW OF WAGES.

ALL persons engaged in industrial pursuits may be divided into two classes—masters and workmen, or, as they are also called, capitalists and labourers—of whom the former work for profit, and the latter for wages. It is of course the masters or capitalists who pay wages;—but out of what do they pay them?—out of their capital, or out of their profit? The notion that wages are paid out of profit is quite fallacious. Profit is obtained only after the goods have been produced and brought to market; but wages are paid while the work of production is going on. Nay, wages are paid, not only before any profit is realized, but often when the work, instead of yielding a profit, subjects the capitalist to loss. It is clear that a ship must be built before the shipbuilder can sell it and make a profit; and it is equally clear that it cannot be built without a previous outlay, not only on timber, and iron, and other materials, but also on wages to support the labourers while at work upon it. Besides, if wages were paid out of profit, not only would workmen have to wait for their wages till the goods were manufactured and sold, but their wages would amount to a mere fraction of what they now are. The profit realized by a capitalist is always of small amount compared with the sum which he pays in wages. Even in that profitable branch of industry, the cotton manufacture, it has been ascertained that, for every pound paid in wages to the operatives, only about half-a-crown goes as profit to the manufacturer: so that if profit was the fund on which wages depended, the weekly earnings of the worker in a cotton factory would be only half-a-crown.

There is, indeed, one way in which a capitalist's profit may eventually affect his workmen's wages. If his profit is so large as to leave him, after defraying his personal and family expenses, a surplus which he may apply to the increase of his capital, the addition thereby made to his capital will necessarily enlarge the fund out of which wages are paid, and tend to the benefit of his workmen. On the other hand, if he incurs loss, or only makes a profit so small that he is forced to draw on his capital for his personal and family expenses, his capital will thereby suffer diminution, and cease, to the extent of that diminution, to be available for the payment of wages. In this way, profit, by increasing capital, may eventually increase wages; and loss, by diminishing capital, diminish wages. But still the fund out of which wages are paid is always capital, not profit. Workmen only betray their ignorance of their own interests when they rail against profit as antagonistic to wages.

Yet, though wages are paid out of capital, the mere amount of capital is not the only thing which regulates them. Even when the capital invested in a factory or other industrial work remains for years the same, the wages of the workmen often vary—being high at one time, and low at another. During the execution of a work, for example, which extends over many months—such as a harbour or a railway—it is but seldom that the rate of wages remains the same from the commencement until the completion of the work. Again, the rate of wages is very different in different trades. Thus, a machine-maker receives higher wages than a mason, and a mason higher wages than a ploughman. And there is also a difference in the rate of wages even in the same trade. How are such diversities to be explained? How comes it that, with the capital unchanged, the wages should fluctuate? How comes it that the wages of different trades should be so different? How comes it that the wages of different workmen even in the same trade should be far from uniform? Let us examine each of these three cases.

We have already seen, in a previous lesson, that the price of all commodities depends not only on the amount of capital expended on their production, but also on the variations between demand and supply. Now, the same is true of the price of labour, or wages. Suppose that in a shipbuilding town there are 1000 shipwrights who, when trade is good, are all employed at a pound a-week each. But trade becomes so dull that the shipbuilders have not work for more than 500; and the other 500 are thrown out of employment. What is the necessary consequence? The unemployed hands cannot afford to remain idle, earning nothing; and rather than go altogether without wages, they are willing to work for less than they formerly received. The shipbuilders, knowing this, forthwith give notice to the 500 still at work, that their wages must be reduced; and these latter, knowing that the unemployed hands would be glad to take their places at the reduced wages, agree to accept lower wages rather than lose their employment. In this case, it is manifest that the reduction in the rate of wages is owing to the supply of labour being greater than the demand for it. But, on the other hand, let trade become so brisk that the existing 1000 shipwrights are too few in number for the work to be done,—what will then be the result? The whole 1000 will obtain not only employment, but employment at advanced wages. For the shipbuilders, being all alike anxious to do as much work as possible while trade continues brisk, will, rather than go without their full complement of work-people, outbid each other for the men's labour; and the effect of such competition for hands will, of course, be to raise wages. It would seem, then, to be a general law, that the price of labour, like that of other commodities, varies with the variations between supply and demand—or, in other words, that wages fall when there are more workpeople than are wanted, and rise when there are fewer than are wanted.

It is substantially the same law which explains the different rates of wages in different trades. Why, for example, does a machine-maker obtain higher wages than a mason? The answer is—Because the demand for machine-makers is greater in proportion to the supply of such workmen than the demand for masons in proportion to the supply of masons. But why, it may be asked, are machine-makers fewer in proportion to the demand for them than masons? Why is there a difference in the supply of hands in different trades? To this question the answer is, that some trades are more difficult to acquire, or demand higher qualifications than others. The work of a physician, for example, is much more difficult, and requires far higher qualifications, than the work of a carpenter; and the work of a carpenter, again, is harder to learn, and demands more knowledge and skill, than that of a ploughman. Now, the difficulty of acquiring and exercising a profession or trade necessarily limits the number of persons who enter it; and this, accordingly, is one, and probably the chief, reason why a physician is better paid than a carpenter; a lawyer than a policeman; a watchmaker than a ploughman; a shopman than a porter. It is true, that some operatives are well paid, whose work is neither hard to learn nor difficult to perform. Men, for instance who work at gunpowder-making, needle-grinding, and the like, usually obtain high wages, though their work requires but little knowledge or skill. But the high rate of wages in such instances forms only an apparent exception to the rule. The danger to life and health which such employments involve, prevents many from undertaking them; and the few who can be got to run the risk are entitled to high wages on the ground that their employment puts them to the cost, if not of superior knowledge and skill, yet of constant exposure to danger. Labour which is difficult to perform commands high wages, because the persons *able* to perform it are necessarily few in number; and labour which involves danger commands high wages, because few are *willing* to undertake it. The case of a successful opera-singer, who sometimes earns a hundred pounds in a single *night, may be* adduced as an example of the effect in *[illegible]ising wages of* both these causes combined. Very few are so highly gifted with vocal powers as to be *able* to be successful singers; and of those still fewer are *willing* to encounter the disparagement which usually attaches to those who appear on the stage. The ability to sing well being rare, and the willingness to sing on the stage still rarer—these two things combined serve to prevent competition, and to secure an apparently extravagant remuneration.

But the rate of wages also differs even in the same trade. It is but seldom that all the operatives in the same workshop are paid alike. Usually, there are two or three rates of wages for what seems at first sight the same work; and those who receive the highest rate are always few in number, compared with those who receive the lowest. This difference is owing to the difference in the industrial ability or productive power of the workman. Workmen even of the same trade differ very materially in skill and diligence—some doing their work much more efficiently and quickly than others; and as it is the interest of the master to have his work always done in the best style and in the shortest possible time, he naturally keeps his eye on his workmen, and gives the highest wages to those of them who are most productive. The more productive any workman is, the more the master desires to have him and retain him. A thoroughly productive workman is seldom dismissed even when work is slack, and is always sure of the highest rate of wages current. And if to thorough industrial ability, he adds the moral qualities of sobriety, honesty, truthfulness, and conscientious fidelity, he is all but certain, not only to command constant employment and good wages, but to rise to some office or position of trust.

Compiled.

SONG OF THE SHIRT.

"Work! work! work!
  Till the brain begins to swim;
Work! work! work!
  Till the eyes are heavy and dim:—

Seam, and gusset, and band,
  Band, and gusset, and seam,—
Till over the buttons I fall asleep,
  And sew them on in a dream!

"Work! work! work!
  My labour never flags:
And what are its wages? A bed of straw—
  A crust of bread and rags—
That shattered roof, and this naked floor—
  A table—a broken chair—
And a wall so blank, my shadow I thank
  For sometimes falling there!

"Work! work! work!
  From weary chime to chime;
Work! work! work!
  As prisoners work for crime!
Band, and gusset, and seam,
  Seam, and gusset, and band,
Till the heart is sick, and the brain benumbed
  As well as the weary hand.

"Work! work! work!
  In the dull December light;
And work! work! work!
  When the weather is warm and bright,
While underneath the eaves
  The brooding swallows cling,
As if to show me their sunny backs,
  And twit me with the Spring.

"Oh! but to breathe the breath
  Of the cowslip and primrose sweet,
With the sky above my head,
  And the grass beneath my feet;
For only one short hour
  To feel as I used to feel,
Before I knew the woes of want,
  And the walk that costs a meal!

"Oh, but for one short hour,—
  A respite, however brief!
No blessed leisure for love or hope,
  And scarcely time for grief!

A little weeping would ease my heart—
But in their briny bed
My tears must stop, for every drop
Hinders needle and thread!"

With fingers weary and worn,
With eyelids heavy and red,
A woman sate in unwomanly rags,
Plying her needle and thread;
Stitch! stitch! stitch!
In poverty, hunger, and dirt;
And still with a voice of dolorous pitch—
Would that its tone could reach the rich!—
She sang this "Song of the Shirt!"

HOOD.

THE ATMOSPHERE.

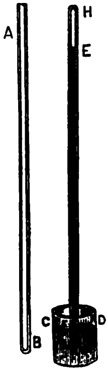
THE earth is surrounded by an ocean of gaseous matter, which extends upward from the surface of the land and water to a height of at least forty-five miles. This gaseous envelope is called the *atmosphere*, and the aggregate gases are called *air*.

All gases are in a high degree *elastic*,—that is, they possess the power of increasing or diminishing in bulk according as they are less or more compressed. A volume of air which under ordinary circumstances occupies the bulk of a cubic inch, may be made, by the removal of the pressure, to expand so as to fill a whole room, while a renewal of the former pressure will reduce it to its former bulk. Nay, so expansive is air, that the smallest portion of it introduced into a large exhausted vessel becomes equally diffused through the whole space, and fills the vessel.

Gravity being, so far as is known, common to all matter, it is natural to expect that gases, being material substances, should be acted upon by the earth's attraction, as well as solids and liquids. This is really the case, and the result is the weight or *pressure* of the atmosphere, which is nothing more than the effect of the attraction of the earth on the particles of air. It is the force of gravity that holds the atmosphere swathed round the earth. Were this force withdrawn, the atmosphere, owing to its elasticity, would be diffused and dissipated throughout space.

The gravity or weight of the atmosphere is so great, that a man of middling stature is computed to sustain, when the air is heaviest, a weight of about fifteen tons. This weight would be insupportable were it not for the equality of the pressure on every part of the body; but, when thus diffused, we can bear even a much greater weight, as, for instance, in bathing, when we support the pressure of the water in addition to that of the atmosphere. Besides this, our bodies contain air, the spring of which counterbalances the weight of the external air, and renders us insensible to its pressure. The weight of the atmosphere, so far from being calculated to injure or incommode us, is in reality essential to our preservation; for, if it were removed, the air within us, meeting with no external pressure to restrain its elasticity, would distend our bodies, and burst the vessels that confine it. On the top of a high mountain, where the atmospheric pressure is much less than at the base, the traveller often bleeds at the nose and mouth, owing to the distension and bursting of bloodvessels in these organs.

It is found by experiment that the atmosphere presses on the earth with a force equal to about 15 lbs. on each square inch of surface, or, in other words, that a column of air, one square inch in base, and equal in height to the atmosphere, weighs about 15 lbs. But, owing to difference of temperature and other causes, this pressure varies slightly at different places, and even at the same place at different times. A well-known instrument, called a *Barometer* or *Weather-glass*, enables us to ascertain and measure both this pressure and its variations. The construction of the barometer is extremely simple. You fill with mercury a glass tube, about three feet in length and closed at one end; then, stopping the open end with your finger, you immerse it in a cup containing mercury. Instead of all the fluid which *is in the tube* running down into the cup, you will find that *only part of it* does so, the remainder continuing in the tube, leaving only a vacant space at its top. The explanation of the phenomenon is this:—The space which the mercury has left in the upper part of the tube, is necessarily a perfect vacuum; and, therefore, the mercury in the tube is relieved from the pressure of the atmosphere, while that in the cup remains exposed to it. The pressure of the air on the mercury in the cup supports the mercury in the tube, and prevents it from falling. In other words, the column of mercury balances the column of atmospheric air. This simple apparatus is all that is essential to a barometer: the tube and the cup are fixed on a board for the convenience of suspending them: the board is graduated to indicate the height at which the mercury stands in the tube; and a small movable metal plate is attached to show that height with greater accuracy. The mercury is in general sustained at the height of about 30 inches: but this height varies according to the weight of the atmosphere, which varies according to the state of the weather. The height is greatest in dry weather, when the pressure of the atmosphere is greatest; and least in wet weather, when the pressure is least.



AB, a glass tube, upwards of thirty-two inches in length, open at A and closed at B.—GH, the same tube filled with mercury, and inverted into a cup, CD, also containing mercury. The mercury in the tube, instead of all running into the cup, will remain in the tube at the height of about thirty inches above the surface CD, leaving the space HE, a vacuum, that is, emptied of air.

The pressure of the atmosphere explains a variety of common phenomena. When you stoop to drink from a running stream, you immerse your mouth in the water; by the effort which you make to draw in the water, a partial vacuum is formed in the mouth; and the water then rises into it by the pressure of the atmosphere upon the surface of the stream. The same cause explains the action of a boy's sucker in lifting large stones—the rise of water in pumps—the firm adhesion of snails and periwinkles to rocks and stones—the crawling of flies on the roof and walls of a room—*and the fact* that the liquid in a cask will not run out by the cock unless a hole be opened in some other part of the cask.

The gases of which atmospheric air is composed are chiefly nitrogen and oxygen; but besides these, there are a little carbonic acid, a trace of ammonia and of carburetted hydrogen, and a very variable proportion of aqueous vapour. The nitrogen and oxygen are in a state of mixture, not of combination—a kind of union which enables each of them to retain its peculiar properties, only modified slightly by the presence of the other. If, instead of being simply mixed, they had been chemically combined, they would have formed a new compound, possessing entirely new properties. Yet though only in a state of mixture, their ratio is as uniform as if they had been in a state of combination; the proportions of nitrogen and oxygen being always and everywhere 77 to 23 parts by weight, and 79 to 21 by measure. The carbonic acid is not thus uniformly diffused, but varies in quantity at different parts of the atmosphere. In some places it forms only $\frac{1}{1000}$ part of the aerial volume; in other places it amounts to wellnigh $\frac{1}{500}$ part; and, singular to say, its great weight does not prevent it from being found in abundance even in the higher regions of the atmosphere. Its natural tendency, indeed, would seem to be rather to sink towards the earth, and there to form a layer of deadly gas, in which neither animal nor plant could live. But, independent of winds and aerial currents, which tend to mix and blend together the different gases of which the air consists, all gases, by the law of their constitution, tend to diffuse themselves through each other, and to abide in a state of mixture. Hence a light gas like hydrogen does not rise wholly to the highest region of the air, there to float on the heavier gases; nor does a heavy gas like carbonic acid sink down so as to rest permanently beneath the lighter gases. On the contrary, all slowly intermix, and become interfused; so that the nitrogen, the oxygen, the hydrogen, and the carbonic acid are found everywhere through the whole atmospheric mass. The aqueous vapour held in solution by the air varies in quantity with the climate and temperature, being generally less in cold seasons and climates than in hot. It seldom forms less than $\frac{1}{500}$ part of the bulk of the air, and its highest amount is about $\frac{1}{50}$. Its presence may be shown, even on the driest days, by pouring ice-cold water into a tumbler, when the vapour in the air will rapidly condense on the outer surface of the tumbler in the form of drops of dew. *Compiled.*

DAILY REVOLUTION OF THE CELESTIAL SPHERE.

SUPPOSE yourself placed on the top of a high mountain or tower, where nothing interrupts your view; the heavens will then appear like a great hemispherical vault above your head, supported by a circular plain, in the centre of which you are placed. The circle which forms the boundary between the heavens and the earth is called the *horizon;* the point directly over your head is called the *zenith;* and the distance from the horizon to the zenith is 90°, being the fourth part of the whole circle of the heavens, which is 360°. Only one-half of the heavens is visible; the other is below the horizon. You are not, therefore, to expect to see all the stars and constellations at once; but only that half of them which, at the time of observation, is above the horizon.

Placed in the situation supposed, you may prepare to examine the face of the sky, after the light of day has disappeared, with a view to ascertain the *apparent* motions of the heavenly bodies. The hemispherical vault will appear studded with an immense number of luminous points or stars. Those that emit a twinkling light,—by far the most numerous class,—are called *fixed stars;* and those that emit a steady light,—of which only three or four are visible to the naked eye,—are called *planets.* If you continue your observations for some time, you will find, that, though the fixed stars preserve their distances from each other, they are continually changing their position with respect to the horizon. Some of them are rising in the east, and others setting in the west. All seem to describe *circles in the heavens;* and all appear to move from east to west. Some, like the sun in winter, rise far south, skim for a few hours the edge of the horizon, and then set. Others, like the sun in spring, rise in the east, traverse the middle of the sky, and set in the west; while others, like the sun at midsummer, rise considerably to the north of the east point, perform a larger circuit through the sky, and set in the north-west. A fourth class, like the sun in the arctic regions, move continually round in the heavens without setting. This last class are always found in the northern regions of the sky; and, by tracing carefully their different orbits, you will find that the circles described by each star gradually become smaller and smaller, till at last you arrive at a star which seems to be at rest, and which appears to be the point (or near the point) around which they all move. This is called the *pole-star*, and nearly coincides with the point at which the axis of the earth would terminate were it produced to the heavens.*

The planets also appear to move across the heavens every night, and consequently round the earth in a day; but there are many peculiarities in regard to their motions which can only be discovered after a series of observations on successive evenings for a considerable period of time. The same remarks apply to the moon, and also to the sun.

Now, what is the cause of this apparent diurnal revolution of all the celestial bodies? Do they actually revolve around the earth once every 24 hours, as they appear to do? or is their motion only apparent, the appearance being caused by the motion of the earth round its own axis in an opposite direction in the same period? Let us attempt to answer the question.

A case may be imagined, where it would be impossible for you to determine which of two bodies was at rest and which in motion. Suppose yourself looking, in a dark night, from the cabin-window of a ship, upon a light apparently in motion,—it would be impossible for you, in this case, to determine which was the moving body. The change of place in the light might arise from its being really in motion, as it would be if it were in another ship passing by, while your ship was at anchor. Or the light might be on shore, and the apparent motion be occasioned by your ship swinging round its anchor or proceeding on its voyage. But in your situation—having no intervening objects, whose place was known, with which to compare the light—you could come to no satisfactory conclusion as to the cause of its apparent change of place. Now, this is precisely the situation in which we stand with respect to the heavenly bodies. As far as appearances enable us to judge, it makes no difference whether the earth is at rest, and the heavens be carried round it in 24 hours, or whether the heavens are at rest, and the earth be carried round itself in the same time.

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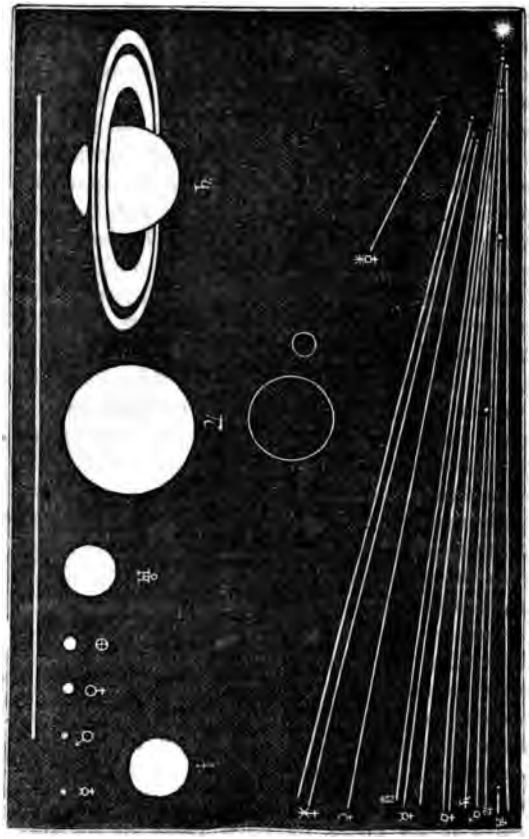
* All this may be illustrated by a celestial globe, by merely turning it round from east to west, provided it is rectified for the latitude; for the extent of circuit performed by any star, and the inclination of its circle to the horizon, depend upon the latitude of the place from which the observation is made.

The question, therefore, resolves itself into this,—Which view of the matter is attended with the fewer difficulties?

If we suppose the earth to revolve on its axis, the apparent daily revolution of the celestial sphere is effected by a motion comparatively moderate; whereas, if the whole heavens actually revolve, the motions necessary for accomplishing this must exceed all calculation. The earth's circumference—or the space through which every point of the equator must pass in 24 hours (supposing the rotation of the earth)—measures 25,000 miles, which would require a motion of 1000 miles per hour, or 500 yards per second,—a speed nearly equal to that of a cannon-ball. This velocity, undoubtedly, is considerable; but it is totally insignificant when compared with the velocities required on the other supposition. The distance of the sun from the earth is about 93 millions of miles; if, therefore, he revolves round the earth in 24 hours, he must move at the rate of nearly 25 millions of miles per hour, which is more than 20,000 times quicker than the motion of a cannon-ball. The planet Herschel is 20 times further distant from us than the sun, and, consequently, the velocity of its daily motion *must be 20* times greater. But these instances, though sufficiently startling, are nothing when compared with the rapidity with which the fixed stars must move to accomplish a revolution in 24 hours. The distance of the nearest of these suns (for suns they are) is at least 20,000,000,000,000 miles,—a space which would require a motion considerably greater than a *thousand millions* of miles *in a second, to* enable a body to pass over it in 24 hours.



The 12 primary planets are distinguished by the annexed characters, viz. ☿ Mercury. ♀ Venus. ⊕ The Earth. ♂ Mars. ⚶ Vesta. ⚵ Juno. ⚳ Ceres. ⚴ Pallas. ♃ Jupiter. ♄ Saturn. ♅ The Georgium Sidus or Herschel. ♆ Neptune. The diagram shows the relative magnitudes of eight of these planets. The line in the margin on the left hand is the sun's semi-diameter on the same scale. The two circles in the centre show the comparative size of the earth and moon. The lines on the right exhibit the inclination of the orbits of the planets, with their mean distances from the sun.

This certainly is a velocity far beyond what we are accustomed to conceive; and yet the velocity of the majority of the fixed stars would be infinitely greater than this. If you consider, therefore, the simplicity of the means employed, and the saving of labour effected by the rotation of the earth on its axis, instead of the revolution of the whole heavens, you can hardly fail to conclude the former to be the true theory of the celestial motions.

This conclusion must appear still more probable, if you attend to the bulks of these different bodies. Of the planets, three greatly exceed the earth in size—Jupiter being nearly 1500 times, Saturn 900 times, and Herschel 80 times larger. The sun is considerably more than a million times the size of the earth; and each of the fixed stars is probably as large as the sun. Such being the magnitude of these bodies, how inconsistent is it with every idea of order to suppose that such immeasurable masses are daily revolving round our comparatively insignificant globe!

But the most satisfactory proof of the earth's motion is derived from the form of the earth itself, and from certain variations in the force of gravity, observed at different parts of its surface. It is found that a clock goes considerably slower at the equator than towards the poles, so that it is necessary, for example, at the equator, to shorten the pendulum $\frac{1}{8}$th of an inch in order to make the time correspond with that of London. How is this to be accounted for? It is not the heat of the climate, though that has the effect of lengthening metallic pendulums; for at Quito, which is covered with snow, the retardation of the clock is the same as at Cayenne. Nor is it the diminution of gravity at the equator, which necessarily causes the pendulum to move more slowly (as the pendulum is an index of the force of gravity);* for, after allowance is made for this, there still remains a considerable retardation to be accounted for.

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* The earth has been determined by actual measurement to be an oblate spheroid, flattened towards the poles and protuberant at the equator; and the force of gravity decreases as we pass from the poles to the *equator, its action* being always from the centre of the earth.

The rotation of the earth alone affords a complete solution of the difficulty. By revolving on its axis, the earth acquires what is called a centrifugal force, which has the effect of diminishing the force of gravity at its surface. But the degree of rotation might be such as entirely to destroy the force of gravity, and even to sweep the waters from the earth's surface, as we see the water fly off from a wet mop in twirling it round with the hand;—or the motion might be so slow as scarcely to prevent the waters from quitting the elevated land at the equator, and flowing towards the lower land at the poles. It is a subject of calculation, therefore, what degree of rotation is necessary to keep the waters uniformly spread out over the whole surface, and, at the same time, to produce that degree of diminution in the action of gravity which is indicated by the retardation of the clock. Now the result of this calculation shows that a rotation of about 24 hours is precisely the degree of velocity requisite for producing these effects. *Compiled.*

THE MOON AND STARS: A FABLE.

At the close of the fourth day of creation, when the sun, after a glorious but solitary course, had gone down, and darkness had begun to gather over the face of the yet uninhabited earth, a star—a single star and beautiful—stept forth in the firmament. Trembling with wonder and delight in new-found existence, she looked abroad, and beheld nothing in heaven nor on earth resembling herself. But she was not long alone. Now one, then another, then a third resplendent companion joined her, till, in the lapse of an hour, the whole hemisphere was bespangled with planets and fixed stars, and with a superb comet which flamed in the zenith.

These orbs for a while contemplated themselves and each other; and every one, from the largest to the least, imagined herself the central luminary of the whole universe. Nor were they undeceived regarding themselves, though all saw their associates in their relative proportions—self-knowledge being the last knowledge acquired in the sky or below it—till, bending over the ocean, they beheld their individual forms reflected beneath, according to their places and configurations above. By an attentive self-inspection in that mirror, they slowly learned humility—all, except the comet, who, having a long train of brightness streaming sunward, continued to regard herself as the Queen of the hemisphere.

While thus examining themselves and each other, their attention was attracted by a slender thread of light, which shone out for a little above the horizon, and then vanished. This was the moon,—the first new moon. Timidly she looked upon the glittering multitude; and as she perceived how mean her scanty and unshapen form appeared in presence of their perfect symmetry, she seemed glad to hide herself from their glances in the friendly bosom of the ocean. When she was gone, the stars looked one at another with inquisitive surprise, as much as to say, "What a figure!" and they soon began to talk freely concerning her. But while they were ridiculing her crooked shape and her shyness, a sudden sense of their own fading splendour came over them. The east began to dawn; and, to their consternation, they all felt themselves fainting into invisibility, and, as they feared, into nothingness.

The next evening, the vanished celestials awoke gradually, and, on opening their eyes, were rejoiced to perceive that not one was wanting of last night's levee. The little gleaming horn, too, was again discerned, bending backward over the western hills; but, though somewhat brighter than on the former occasion, she again sunk early beneath the horizon, leaving the comet in proud possession of the sky.

On the third evening, the moon was so obviously increased in size and splendour, and stood so much higher in the firmament than at first, though she still hastened out of sight, that she was the sole subject of conversation on both sides of the galaxy, till the breeze, that awakened newly created man from his first slumber in Paradise, warned the stars to retire, and the sun, with a pomp never witnessed in our degenerate days, ushered in the first Sabbath of creation. The following night, the moon took her station still higher, and looked brighter than before, insomuch that it was remarked of the lesser stars in her vicinity, that many of them were paler, and some no longer visible. As their associates knew not how to account for this, they naturally enough presumed that her light was fed by the absorption of theirs; and the alarm became general that she would thus continue to thrive by consuming her neighbours, till she had incorporated them all with herself.

Though thus growing larger and lovelier every night, the moon preserved her humility, till her crescent swelled into a gibbous form. Then, however, she began to feel proud of her preferment. Her rays, too, became so dazzling, that fewer and fewer of the stars could endure her presence: even the comet became wan before her. On the night of her fulness, she triumphed gloriously in mid-heaven, and arrayed the earth in softer day. Over the ocean she hung, enamoured of her own beauty, reflected in the abyss. And the few stars that still continued to sparkle in the firmament shrunk into bluer depths of ether, to gaze at a safe distance upon her all-conquering resplendence.

The moon herself was not a little puzzled to imagine to what size and splendour she might grow. Her vanity suggested that, although she had reached her full form, she had not reached her full size. Might she not go on increasing till man and his companion, woman, looking upward from the bowers of Eden, would see the heaven *all moon?* But, in the midst of this self-pleasing illusion, a film crept upon her, which spread from her utmost verge athwart her centre, till it completely eclipsed her visage, and made her a blot on the tablet of the heavens. In the progress of this disaster, the stars, which were hid in her pomp, stole forth to witness her humiliation. But their transport and her shame lasted not long: the shadow retired gradually as it had advanced, leaving her fairer, by contrast, than before.

Another day went, and another night came; and she rose, as usual, a little later. Even while she travelled above the land, she was haunted with the idea that her lustre was rather feebler than it had been; but when she beheld her face in the sea, she could no longer overlook the unwelcome defect. The season was boisterous; the wind rose suddenly, and the waves burst into foam. Perhaps the tide, for the first time, then was affected by sympathy with the moon; and, what had never happened before, a furious tempest rent the sky with thunder and swept the earth with torrents of rain. She plunged among the thickest of the thunder clouds, and, in the confusion that hid her disgrace, her exulting rivals were all likewise put out of countenance.

On the next evening and for several evenings afterwards, the moon came forth later and dimmer; while, on each occasion, more and more of the minor stars, which had formerly vanished before her, reappeared to witness her fading honours and disfigured form. Prosperity had made her vain; adversity brought her back to her better mind; and the softer charms of humility soon won the regard which haughtiness had repelled: for when her gibbous profile waned, through the last quarter, into a hollow shell, she appeared more graceful than ever in the eyes of all heaven.

At length, there came a night when there was no moon. The comet had likewise departed into unknown regions. There was silence in heaven all that night. In serene meditation on the changes of a month, the stars pursued their journey from sunset to daybreak; and, wiser by experience, they were humble and contented, and each grateful for her lot, whether splendid or obscure.

Next evening, to the astonishment and joy of all, the moon, with a new crescent, was descried in the west; and instantly, from every quarter of the sky, she was congratulated on her happy resurrection. Just as she went down, while her bow was yet recumbent on the dark purple horizon, it is said that an angel appeared, standing between her horns. Turning his head, his eye glanced rapidly over the universe,—the sun sunk far behind him, the moon under his feet, the earth spread in prospect before him, and the firmament all glittering with constellations above. He paused a moment, and then, in that tongue in which "the morning stars sang *together*, and all the sons of God shouted for joy," he thus brake forth:—"Great and marvellous are thy works, Lord God Almighty! in wisdom hast thou made them all!" . He ceased,—and, from that hour, there has been harmony in heaven. MONTGOMERY.

A MOONLIGHT NIGHT AT VENICE.

'TIS
A goodly night; the cloudy wind which blew
From the Levant hath crept into its cave,
And the broad moon has brightened. What a stillness!
And what a contrast with the scene I left,
Where the tall torches and the silver lamps
Spread over the reluctant gloom, which haunts
Those vast and dimly-latticed galleries,
A dazzling mass of artificial light,
Which showed all things, but nothing as they were.
There Age essaying to recall the past,
After long striving for the hues of youth
At the sad labour of the toilet, and
Full many a glance at the too-faithful mirror,
Forgot itself, and trusting to the falsehood
Of the indulgent beams, which show, yet hide,
Believed itself forgotten, and was fooled.
There Youth, which needed not, nor thought of such
Vain adjuncts, lavished its true bloom, and health,
And bridal beauty, in the unwholesome press
Of flushed and crowded wassailers, and wasted
Its hours of rest in dreaming this was pleasure,
And so shall waste them till the sunrise streams
On sallow cheeks and sunken eyes, which should not
Have worn this aspect yet for many a year.
The music, and the banquet, and the wine,
The garlands, the rose-odours, and the flowers,
The sparkling eyes, and flashing ornaments—
All the delusion of the dizzy scene,—
Are gone. Around me are the stars and waters—
Worlds mirrored in the ocean, goodlier sight
Than torches glared back by a gaudy glass;
And the great element, which is to space
What ocean is to earth, spreads its blue depths,

Softened with the first breathings of the spring;
The high moon sails upon her beauteous way,
Serenely smoothing o'er the lofty walls
Of those tall piles and sea-girt palaces,
Whose porphyry pillars, and whose costly fronts,
Seem each a trophy of some mighty deed
Reared up from out the waters, scarce less strangely
Than those more massy and mysterious giants
Of architecture, those Titanian fabrics,
Which point in Egypt's plains to times that have
No other record. All is gentle: nought
Stirs rudely; but, congenial with the night,
Whatever walks is gliding like a spirit.
The tinklings of some soft guitars; the dash
Phosphoric of the oar, or rapid twinkle
Of the far lights of skimming gondolas,
And the responsive voices of the choir
Of boatmen answering back with verse for verse;
Some dusky shadow chequering the Rialto;
Some glimmering palace-roof, or tapering spire,
Are all the sights and sounds which here pervade
The ocean-born and earth-commanding city—
How sweet and soothing is this hour of calm! BYRON.

THE SPREAD OF THE GOSPEL.

THAT the religion of Jesus is destined to abide and spread on earth may be reasonably presumed from the fact that it has already kept its place in this bad world for well nigh nineteen hundred years. Little human probability was there at its commencement that it would run so long a course, or indeed any course at all. Though of heavenly birth, yet it stepped down on the earth from a malefactor's cross; and, being completely identified in the eyes of both Jew and Gentile with its despised and obnoxious Founder, it had everywhere to encounter a hostility which its own exclusive claims and uncompromising principles only served to envenom. It had all the world against it, and nothing on its side but the still small voice of conscience. Yet it not only held *its own, but* evermore made way,—progressive in [illegible] face of opposition, and steadfast in the midst of change. Over all other things a mighty revolution has passed since the time when the Apostles first went forth to teach and baptize, beginning at Jerusalem. The cities where they planted churches are for the most part in ruins; the countries which they traversed on their errand of mercy have passed from conqueror to conqueror, and from race to race; the philosophies and mythologies of the age have left scarce a name behind; even the great empire of the Caesars, which then bestrode, Colossus-like, a subject world, has long been but a phantom of the past. And yet here to-day, in this remote island of the West—and not here only, but throughout a Christendom so wide that the sun never sets upon it—are those truths still preached which the Apostles taught, and those sacraments administered which the Apostles transmitted. The Gospel is but a book; and yet, while many other books and even entire literatures have perished in Time's devouring furnace, it still survives without a hair of its head so much as singed, or even the smell of fire upon it. The sacraments are outwardly but ceremonies; and yet, while all the splendid rites and pageants of classical Paganism have vanished like the tinted clouds at sunset, these simple ordinances—the sprinkling of the infant's brow with pure water, and the partaking of bread and wine at a communion table—still hold their place, and still symbolize and seal to countless multitudes the love and grace of the crucified Nazarene.

But, apart from the past triumphs of the Gospel, there is a hopeful augury for its future spread in the present tendencies of the world. By nothing is the present age more distinguished than by the expansiveness of its aims and movements. Think of the recent progress of the locomotive arts, and the rapid increase of emigration and travel! See how commerce is everywhere overstepping its former bounds, and hastening to open every port to every product! See how science, instead of abiding as of old within the walls of colleges, is coming forth from its cloistered retreats to dwell wherever men will give it welcome and entertainment! Literature, too, in place of being, as once it was, a luxury for only the learned and the opulent, is now diffused by a cheap press among the humblest of the people. Even in the fine arts is the same tendency apparent; for not a few masterpieces of painting and sculpture, originally designed for the galleries of princes, are now to be found, under the form of casts and engravings, in the abodes of tradesmen and mechanics. It would be strange if, amid this universal expansiveness, the Gospel of Christ stood still. But does it stand still? No, verily. Never at any former period was the great principle so generally recognised, that Divine truth is every man's property, and ought to be every man's possession. Never at any former period was the conviction so widely felt, that it devolves, not on accredited teachers alone, but on all Christian men and women, to co-operate for the spread of the Gospel. Never before were so many Bibles in circulation, so many Sunday-schools at work, so many religious tracts on the wing, so many Christian associations under arms for the great contest with moral evil. In fact, Christian Benevolence now musters and commands larger armies than War can bring into the field; nor is there almost any stronghold of sin and Satan, which she does not boldly confront and challenge to surrender. The cell of the criminal is not too dismal for her to invade. The smoky cellars and shivering garrets of the poor are not too squalid for her to enter. She stands up for the slave, and insists on his being released from his bonds and recognised as a brother. She lays hold of the ragged child amid the mire and destitution of the street, and strives to make him a scholar and soldier of Christ. Nay, not content with doing battle against vice and misery at home, she crosses the ocean, and traverses all lands with the sword of the Spirit in her hand, and the music of salvation on her lips,—desirous and determined to plant Christ's banner on every shore, and never to pause in her holy war with evil until the kingdoms of this world have become the kingdom of God's anointed Son.

Nor ought we to forget how happy it is for the world that the diffusive tendency of the age is evinced, not in the spread of *science* and literature and art merely, but in the spread of the Gospel as well. Many, indeed, talk as if a diffused taste for books and pictures and music were a sure mark of social and moral progress; and with them the approved nostrum for humanizing and elevating a people is to cover a land with museums and libraries and picture-galleries; but does past history prove such things to be any real boon to a community in the absence of Christian truth and Christian principle? Ancient Greece was resplendent all over with the choicest triumphs of literature and art; but did *that* prevent the Greeks from being a byword among the nations for perfidy? Modern Paris, on the eve of the first revolution, had its academies of science, and its galleries of painting and sculpture, and its magnificent Versailles, where thousands upon thousands assembled every Sunday to gaze on fair statuary, and yet fairer fountains, and to keep holiday amid gay parterres of flowers and orange-trees; but did *that* prevent Paris from becoming a very Aceldama? did *that* blunt the edge of the guillotine, or shorten the duration of the Reign of Terror? Literature and science and art will doubtless promote men's true progress, when they are underlaid by that public and private virtue which the Gospel produces and sustains. But, in the case of a people devoid of moral and religious principle, they are only an intoxicating cup to prepare men more speedily for ruin. Nations are great, not in the measure in which they live amidst flowers and fountains and statuary, but in the measure in which they will not lie, will not cheat, will not act a mean and selfish, but a generous and noble part. It is only through the knowledge and belief of the Gospel that a people can be trained to that love of truth and of righteousness which is the true source of national strength and greatness. And hence, with all our admiration of the triumphs recently achieved in the fields of science and invention, we should count them but an equivocal sign of the times, were it not that they are accompanied by a correspondent outspread of Christianity.

PROPERTIES OF HEAT.

THE chief properties of Heat, or Caloric as it is sometimes called, are Radiation and Conduction.

Radiation.—Heat always tends, not only to diffuse itself, but to diffuse itself equally. When two bodies are of different temperatures, the warmer gradually parts with its heat to the colder, till both are brought to the same temperature. Thus, when a thermometer is applied to a hot body it receives heat, when to a cold one it communicates part of its own heat, and this communication continues until the thermometer and the body arrive at the same temperature. Cold is not a positive quality, but merely the abstraction of heat. When you lay your hand on a marble table you indeed feel it *positively* cold; but the cold you experience consists merely in the loss of heat that your hand sustains while its temperature is being brought to an equilibrium with the marble. If you lay a piece of ice upon the table, you will find that the contrary effect will take place,—the ice will be melted by the heat which it abstracts from the marble. And not only do the hotter bodies emit rays of heat to the colder, but there seems to be a reciprocal radiation among bodies. All bodies whatever appear to be constantly radiating or emitting heat; the hotter emitting to the colder, and the colder to the hotter; nor is it more extraordinary that a hot body should receive heat from a cold one, than that a candle should send forth rays of light to the sun, which yet must necessarily happen.

Different bodies—or different surfaces, rather—possess the power of radiating heat in very different degrees. From experiments made on this subject, it appears that black surfaces radiate most, white next, and polished surfaces the least of all. Hence it is that light-coloured clothes, in cold weather, keep us warmer than black ones; hence also a metallic vessel preserves the heat of the liquid within better than one of any other materials; silver teapots, for instance, make better tea than those of earthenware. The property which different surfaces possess of radiating in different degrees may appear to be at variance with the doctrine respecting the equilibrium of heat, inasmuch as it would seem to imply that those bodies which radiate most must ultimately become coldest. But it is to be recollected that the power of absorbing heat is always proportionate to the power of radiation; so that, in equal temperatures, bodies compensate, by their greater absorption, the loss which they sustain by their greater radiation.

Conduction.—In establishing an equilibrium of temperature, heat is conveyed to surrounding objects, not only by radiation —or by an interchange *from a distance*—but also by *conduction* through intermediate bodies. Heat passes through bodies with different degrees of velocity. Some substances oppose very little impediment to its passage, while it is transmitted slowly by others. Daily experience teaches, that though we cannot leave one end of a rod of iron for some time in the fire, and then grasp its other extremity, without danger of being burnt, yet this may be done with perfect safety with a rod of glass or of wood. The heat will speedily traverse the iron bar, so that, at the distance of a foot from the fire, it is too hot to be handled; while we may hold a piece of redhot glass two or three inches from its extremity, or keep a piece of burning charcoal in the hand, though the part in combustion is only a few lines removed from the skin. The observation of these and similar facts has led to a division of bodies into conductors and non-conductors of heat. The former class includes bodies which allow heat to pass freely through their substances: the latter comprises bodies which do not give an easy passage to heat.

It has been ascertained by experiment, that the metals are the best conductors of heat, and that of the metals silver is the best, copper the next, gold the third, and bismuth the worst. Next to the metals, though far behind them, crystals, glass, and stones are the best conductors; but these differ as much among themselves as the metals do. Substances which belong to the animal and vegetable kingdoms, such as furs, wool, silk, cotton, etc., are extremely imperfect conductors,—a property which, doubtless, serves, not only to guide us in the choice of our clothing, but also, in some degree, to protect animals and vegetables from the injurious effects of sudden changes of temperature.

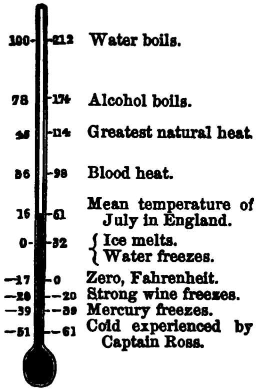
Abridged from TURNER.

EFFECTS OF HEAT.

THE principal phenomena which accompany the passage of heat into substances, are Expansion, Liquefaction, and Vaporization. The phenomena that attend its escape from them, viz., Contraction, Solidification of Fluids, and Condensation of Vapour, are merely the converse of these.

Expansion.—The effect of heat is directly contrary to that of the attraction of cohesion—the one drawing the particles together, the other driving them asunder—and from the continual struggle between these two forces result all the various degrees of consistence which bodies assume. Different bodies dilate in very different proportions,—liquids being much more dilatable than solid bodies, and gases much more dilatable than liquids.

It is in consequence of the great expansibility of liquids that they are used for filling thermometers. A *thermometer* consists of a tube, with a bulb containing a fluid, whose degrees of dilatation are indicated by a scale to which the tube is fixed. The fluid generally used is mercury, because its dilatations and contractions are found to correspond more exactly to the additions and subtractions of heat than those of any other fluid. The degree on the scale that indicates the boiling point simply means that, when the mercury is sufficiently dilated to rise to this point, the heat is such, that water exposed to the same temperature will boil; and when the fluid is so much condensed as to sink to the freezing-point, we are to understand that *water will freeze* at that temperature. The extreme points of the scale are not the same in all thermometers, nor are the degrees always divided in the same manner. Fahrenheit's scale, which is generally used in Great Britain, is divided into 212 degrees, in which 32° corresponds with the freezing-point, and 212° with the point of boiling water. The Centigrade thermometer, used on the Continent, is divided into 100 degrees, in which 0° denotes the freezing point, and 100° that of boiling water.


100 — 212 Water boils.
78 — 174 Alcohol boils.
46 — 114 Greatest natural heat.
36 — 98 Blood heat.
16 — 61 Mean temperature of July in England.
0 — 32 Ice melts. Water freezes.
−17 — 0 Zero, Fahrenheit.
−28 — −20 Strong wine freezes.
−39 — −39 Mercury freezes.
−51 — −61 Cold experienced by Captain Ross.

Thermometer, with the mercury standing at mean summer heat, and a scale of the chief points of temperature. On the right side, the scale is that of Fahrenheit: the corresponding degrees, on the left side, are those of the Centigrade scale.

As liquids expand more readily than solids, so aeriform fluids are more expansible than liquids; and one circumstance respecting their dilatation deserves to be particularly noticed—they all undergo the same degree of expansion from equal augmentations of temperature, though they vary in density more than either liquids or solids. This uniformity of expansibility, extraordinary as it may appear, is readily accounted for; for if bodies owe their different susceptibilities of expansion to their various degrees of attraction of cohesion, no such difference can be expected in permanently elastic fluids, since in these the attraction of cohesion does not operate.

Liquefaction.—All bodies are either solid, liquid, or gaseous; and the form which they assume depends upon the relative force of cohesion and heat. As it is easy to increase or diminish the quantity of heat in any substance, it follows that the form of bodies may be made to vary at pleasure; that is, by a sufficiently intense heat every solid may be converted into a fluid, and every fluid into the aeriform state. This inference is justified by experience so far that *it may safely be* considered a general law. The converse [illegible] *also to be* true; and, accordingly, various gases have been condensed, by cold and pressure, into liquids, and many liquids have been solidified.

The most important circumstance relative to liquefaction is the discovery of Dr Black, that a large quantity of heat disappears, or becomes insensible to the thermometer, during the process. If ice be placed above a lamp, it will indicate a gradual rise of temperature—as may be ascertained by placing a thermometer in it—till it arrive at 32° and begin to melt; but no further rise will take place during the process of liquefaction. It will remain stationary at 32°, notwithstanding that it is all along receiving accessions of heat from the lamp, till the process is completed; and all the heat which is added will become insensible. The explanation which Dr Black gave of these phenomena constitutes what is called his doctrine of *latent heat.* He considered that heat loses its property of acting on the thermometer, in consequence of combining chemically with the solid substance, and that the liquefaction is the result of this combination.

As so much heat disappears during liquefaction, it follows that heat must be evolved when a liquid passes into a solid. This may easily be proved. The temperature of water in the act of freezing never falls below 32° F., though it be exposed to an atmosphere in which the thermometer is at zero. It is obvious that the water can preserve its temperature, in a medium so much colder than itself, only by the heat which it loses being instantly supplied; and it is no less clear that the only source of supply is the heat that was insensible in the fluid.

Vaporization.—Vaporization is conveniently studied under two heads, Ebullition or Boiling, and Evaporation. In the first, the production of vapour is so rapid that its escape gives rise to a visible commotion in the liquid; in the second it passes off quietly and insensibly.

The temperature at which vapour rises with sufficient freedom to cause the phenomena of *Ebullition*, is called the boiling-point. The heat requisite for this effect varies with the nature of the fluid. Thus, sulphuric ether boils at 96° F., alcohol at 173°, *and* pure water at 212°; while oil of turpentine must be raised to 316°, and mercury to 660°, before either shows marks of ebullition. Even the boiling-point of the same liquid is liable to be affected by several circumstances. The nature of the vessel has some influence upon it. Thus, pure water boils precisely at 212° in a metallic vessel, and at 214° in one of glass. It is likewise affected by the presence of foreign particles. But the circumstance which has the greatest influence is variation of pressure. All bodies upon the earth are constantly exposed to the pressure of the atmosphere. Liquids are exposed to this pressure as well as solids, and their tendency to take the form of vapour is very much counteracted by it. In fact, they cannot enter into ebullition at all till their particles have acquired such an elastic force as enables them to overcome the pressure upon their surfaces; that is, till they press against the atmosphere with a force equal to that with which the atmosphere presses against them. The only time at which the pressure of the atmosphere is equal to a weight of 15 pounds on every square inch of surface, is when the barometer stands at 30 inches, and then only does water boil at 212° F. If the pressure be less — that is, if the barometer fall below 30 inches — then the boiling-point of water, and of every other liquid, will be lower than usual; or, if the barometer rise above 30 inches, the temperature of ebullition will be proportionally increased. This is the reason why water boils at a lower temperature on the top of a hill than in the valley beneath it; for as the column of air diminishes in length as we ascend, its pressure must likewise suffer a proportional diminution. The ratio between the depression of the boiling-point and the diminution of the atmospherical pressure is so exact, that it has been proposed as a method for determining the heights of mountains:—an elevation of 530 feet makes a diminution of one degree of Fahrenheit. The influence of the atmosphere over the point of ebullition is best shown by removing its pressure altogether. Fluids boil in *vacuo* at a temperature 140 degrees lower than in the open air. Thus water boils at 72° F., alcohol at 33°, and ether at —44°. This proves that a liquid is not necessarily hot because it boils.

The formation of vapour is attended, like liquefaction, with a loss of sensible heat. This is proved by the well-known fact, that the temperature of steam is precisely the same as that of the boiling water from which it rises; so that all the heat which enters into the liquid is employed solely in converting a portion of it into vapour, without affecting the temperature of either. The heat which then becomes latent is again set free when the vapour is condensed into water.

Evaporation takes place at common temperatures, as may be proved by exposing water in a shallow vessel to the air for a few days, when it will gradually diminish, and at last disappear entirely. Most fluids, if not all of them, are susceptible of this gradual dissipation; and it may also be observed in some solids,—as, for example, in camphor. Those liquids whose boiling-point is lowest, evaporate with the greatest rapidity.

The chief circumstances that influence evaporation are extent of surface, and the state of the air as to temperature, dryness, stillness, and density. The effect of heat in promoting it may easily be shown by putting an equal quantity of water into two saucers, one placed in a warm, the other in a cold situation. The former will be quite dry before the latter has suffered an appreciable diminution. When water is covered by a stratum of dry air, the evaporation is rapid even when the temperature is low; whereas it goes on very tardily if the atmosphere contains much vapour, even though the air be very warm. It is far slower in still air than in a current, because the air immediately in contact with the water soon becomes moist, and thus puts a check to it. Pressure, too, has a remarkable influence over it. This is easily proved by placing ether in the vacuum of an air-pump, when vapour rises so abundantly as to produce ebullition.*

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* As a large quantity of heat passes from a sensible to an insensible state during the formation of vapour, it follows that cold should be generated by evaporation. Water placed under the exhausted receiver of an air-pump evaporates with great rapidity; and so much

The presence of watery vapour in the atmosphere is owing to evaporation. The water upon the surface of the earth and the sea is subjected by its means to a natural distillation; the impurities with which the water is impregnated remaining behind, while the pure vapour ascends into the air to give rise to a multitude of meteorological phenomena. And as evaporation goes on to a certain extent, even at low temperatures, it is probable that the atmosphere is never absolutely free of vapour. *Abridged from* TURNER.

SPECIMENS OF THE POETRY OF THE SIXTEENTH AND SEVENTEENTH CENTURIES

(*Chronologically arranged*).

GIVE me my scallop shell of quiet,
  My staff of faith to walk upon;
My scrip of joy, immortal diet;
  My bottle of salvation;
My gown of glory (hope's true gage)—
  And thus I'll take my pilgrimage.
SIR WALTER RALEIGH (*born* 1552).

AND is there care in Heaven? and is there love
  In heavenly spirits to these creatures base,
That may compassion of their evils move?
  There is; else much more wretched were the case
  Of men than beasts: But oh! the exceeding grace
Of highest God, that loves his creatures so,
  And all his works with mercy doth embrace,
That blessed angels he sends to and fro,
To serve to wicked man,—to serve his wicked foe!

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cold is generated as would freeze the water, did the vapour continue to rise for some time with the same velocity. But the vapour itself soon fills the vacuum, and retards the evaporation by pressing upon the surface of the water. This difficulty may be avoided by putting under the receiver a substance, such as sulphuric acid, which has the property of absorbing watery vapour, and consequently of removing it as quickly as it forms. Such is the principle of Sir John Leslie's method for freezing water by its own evaporation.

How oft do they their silver bowers leave,
  To come to succour us that succour want!
How oft do they with golden pinions cleave
  The flitting skies, like flying pursuivant,
  Against foul fiends to aid us militant!
They for us fight, they watch and duly ward,
  And their bright squadrons round about us plant;
And all for love and nothing for reward;
Oh, why should heavenly God to man have such regard?

EDMUND SPENSER (*b.* 1553).

ALL the world's a stage,
And all the men and women merely players:
They have their exits, and their entrances;
And one man in his time plays many parts,
His acts being seven ages. At first, the Infant
Mewling and puking in the nurse's arms;
And then, the whining School-boy, with his satchel,
And shining morning-face, creeping like snail
Unwillingly to school. And then, the Lover,
Sighing like furnace, with a woful ballad
Made to his mistress' eye-brow. Then, a Soldier,
Full of strange oaths, and bearded like the pard,
Jealous in honour, sudden, and quick in quarrel,
Seeking the bubble reputation
Even in the cannon's mouth. And then, the Justice,
In fair round belly, with good capon lined,
With eyes severe, and beard of formal cut,
Full of wise saws and modern instances;
And so he plays his part. The sixth age shifts
Into the lean and slippered Pantaloon,
With spectacles on nose, and pouch on side;
His youthful hose well saved, a world too wide
For his shrunk shank; and his big manly voice,
Turning again toward childish treble, pipes
And whistles in his sound. Last scene of all,
That ends this strange eventful history,
Is second childishness, and mere oblivion,
Sans teeth, sans eyes, sans taste, sans every thing.

WILLIAM SHAKSPEARE (b. 1564).

It is not growing like a tree
In bulk, doth make men better be;
Or standing long an oak, three hundred year,
To fall a log at last, dry, bald, and sear:
A lily of a day
Is fairer far in May,
Although it fall and die that night;
It was the plant and flower of light.
In small proportions we just beauties see;
And in short measures, life may perfect be.

Ben Jonson (*b.* 1574).

Sweet day! so cool, so calm, so bright,
The bridal of the earth and sky,
Sweet dews shall weep thy fall to-night,
For thou must die.

Sweet rose! whose hue, angry and brave,
Bids the rash gazer wipe his eye,
Thy root is ever in its grave,
And thou must die.

Sweet spring! full of sweet days and roses,
A box where sweets compacted lie,
My music shows you have your closes,
And all must die.

Only a sweet and virtuous soul,
Like seasoned timber, never gives;
But when the whole world turns to coal,
Then chiefly lives.

George Herbert (*b.* 1593).

Hail, holy light! . . . Thee I revisit safe,
And feel thy sov'reign vital lamp; but thou
Revisit'st not these eyes, that roll in vain
To find thy piercing ray, and find no dawn;
So thick a drop serene hath quenched their orbs,
Or dim suffusion veiled. Yet not the more
Cease I to wander, where the Muses haunt,
Clear spring, or shady grove, or sunny hill,
Smit with the love of sacred song; but chief

Thee, Sion, and the flowery brooks beneath,
That wash thy hallowed feet, and warbling flow,
Nightly I visit : nor sometimes forget
Those other two equalled with me in fate,
So were I equalled with them in renown,
Blind Thamyris, and blind Mæonides,
And Tiresias, and Phineus, prophets old:
Then feed on thoughts, that voluntary move
Harmonious numbers; as the wakeful bird
Sings darkling, and in shadiest covert hid
Tunes her nocturnal note. Thus with the year
Seasons return; but not to me returns
Day, or the sweet approach of even or morn,
Or sight of vernal bloom, or summer's rose,
Or flocks, or herds, or human face divine;
But cloud instead, and ever-during dark
Surrounds me; from the cheerful ways of men
Cut off, and for the book of knowledge fair
Presented with a universal blank
Of Nature's works to me expunged and rased,
And wisdom at one entrance quite shut out.
So much the rather thou, celestial Light,
Shine inward, and the Mind through all her power
Irradiate, there plant eyes, all mist from thence
Purge and disperse, that I may see and tell
Of things invisible to mortal sight.

JOHN MILTON (*b.* 1608).

HIS puissant sword unto his side,
Near his undaunted heart, was tied,
With basket-hilt that would hold broth,
And serve for fight and dinner both;
In it he melted lead for bullets
To shoot at foes, and sometimes pullets,
To whom he bore so fell a grutch,
He ne'er gave quarter to any such.
The trenchant blade, Toledo trusty,
For want of fighting was grown rusty,
And ate into itself, for lack
Of somebody to hew and hack:
The peaceful scabbard, where it dwelt,
The rancour of its edge had felt;

For of the lower end two handful
It had devoured, it was so manful.
This sword a dagger had, his page,
That was but little for his age,
And therefore waited on him so
As dwarfs upon knight-errants do:
It was a serviceable dudgeon,
Either for fighting or for drudging:
When it had stabbed, or broke a head,
It would scrape trenchers, or chip bread,
Toast cheese or bacon, though it were
To bait a mouse-trap, 't would not care;
'T would make clean shoes, and in the earth
Set leeks and onions, and so forth:
It had been 'prentice to a brewer,
Where this and more it did endure,
But left the trade, as many more
Have lately done on the same score.

SAMUEL BUTLER (*b.* 1612).

OF these the false Achitophel* was first,
A name to all succeeding ages curst:
For close designs and crooked counsels fit;
Sagacious, bold, and turbulent of wit;
Restless, unfixed in principles and place,
In power unpleased, impatient of disgrace:
A fiery soul, which, working out its way,
Fretted the pigmy body to decay,
And o'er-informed the tenement of clay.
A daring pilot in extremity;
Pleased with the danger, when the waves went high,
He sought the storms; but, for a calm unfit,
Would steer too nigh the sands, to boast his wit.
Great wits are sure to madness near allied,
And thin partitions do their bounds divide;
Else, why should he, with wealth and honour blest,
Refuse his age the needful hours of rest?
Punish a body which he could not please;
Bankrupt of life, yet prodigal of ease?

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* Anthony Ashley Cooper, Earl of Shaftesbury.

And all to leave, what with his toil he won,
To that unfeathered, two-legged thing, a son!
In friendship false, implacable in hate,
Resolved to ruin, or to rule, the state.
Then, seized with fear, yet still affecting fame,
Usurped a patriot's all-atoning name:
So easy still it proves, in factious times,
With public zeal to cancel private crimes.
Yet, fame deserved, no enemy can grudge,
The statesman we abhor, but praise the judge.
In Israel's courts ne'er sat an Abethdin
With more discerning eyes, or hands more clean,
Unbribed, unsought, the wretched to redress,
Swift of despatch, and easy of access.
Oh! had he been content to serve the crown,
With virtues only proper to the gown,
David for him his tuneful harp had strung,
And Heaven had wanted one immortal song.

JOHN DRYDEN (*b.* 1631).

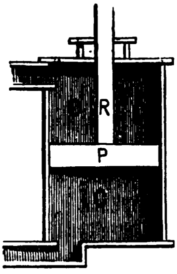
SECTION V.

JAMES WATT AND THE STEAM-ENGINE.

THE marvellous feats ascribed, in the age of romance, to magicians and goblins, have been more than realized in our times by that wonder-worker, Steam. How amazing are the services to man which that modern giant renders, when armed with the necessary mechanical appliances! Are the thousand wheels and spindles of a factory to be made to spin cotton yarn for us? Summon up the ready vassal steam, and he will impel them to do their work with a gentler touch than that of a lady, and with greater power and persistency than forty horses. Is force wanted to drive those massive hammers and rollers which mould the glowing iron like dough? Not Vulcan, with all his Cyclops, could manage the process so dexterously as steam. Go into the printing office, where thousands of copies of a journal are required before day has well dawned, and there the busy giant is at work, patiently twirling the type-covered cylinders, and stamping their news upon broad sheets, which will be scattered over England before sunset. Do you wish to traverse the island at the rate of some forty miles an hour? Put the faithful steam in harness, and that which all the griffins of mythology could not have accomplished, had they been yoked to the vehicle, he will effect with the precision of an intelligent being. In short, wherever science has obtained a firm footing, we see this noble helot of civilisation charging himself with the chief drudgery of our planet—pumping, sawing, printing, coining, spinning, blasting, forging, propelling—and all without one murmur at the severity of the labour, and without needing a single holiday.

For conjuring up this valuable goblin from the vasty deep of thought, or, at least, for setting him to labour for us, we are indebted to the inventive genius and skill of one remarkable man—JAMES WATT.

The specific work of the steam-engine is to set and keep in motion other machinery—as, for example, the spindles of a cotton factory, or the paddles of a steam-ship—and its power of doing this depends upon two properties of steam, namely, the expansive power communicated to that vapour by heat, and the ready conversion of that vapour into water by cold. There must, of course, be a water-boiler and furnace to generate steam; and, in order that the steam thus generated may act on the machinery which is to be put in motion, there must also be an intermediate apparatus to transmit to the machinery the motive force produced by the steam. This intermediate apparatus is the *steam-engine*, which consists essentially of a cylinder of metal, with a movable piston within, and a piston-rod connected with the machinery to be put in motion. It is obvious that if the steam can be so applied in the cylinder as to drive the piston alternately from the bottom to the top, then the piston-rod will alternately ascend and descend, and thereby communicate motion to any oscillating beam or other machinery with which it happens to be connected. But how is the steam to be applied in the cylinder, so as to effect this result most effectually and economically? This is the grand problem which James Watt was the first to solve.



C, cylinder.
P, piston.
R, piston-rod

In the winter of 1763–64, Watt, who was then "mathematical instrument maker" to the University of Glasgow, was employed to repair a small model of Newcomen's engine belonging to the university; and it was while attempting to provide a remedy for its defects that he made his first and greatest discovery. In Newcomen's engine the steam, after raising the piston to the top of the cylinder, was condensed by allowing a jet of cold water to enter. In consequence, a partial vacuum was produced beneath the piston, and the pressure of the atmosphere upon the upper surface of the piston then forced it down; just as the plunger of a squirt, if raised when the hole is stopped, will be driven to the bottom of the tube the moment the hand is withdrawn. Watt's quick eye soon discovered that one great defect in the engine was the slowness and incompleteness with which the vacuum was produced. The steam was so imperfectly condensed beneath the piston, that the atmospheric pressure above was insufficient to cause a rapid down-stroke. This, he saw, might be obviated by injecting a larger quantity of cold water. But there was a *per contra* side. The more effectually the process of cooling was executed during the down-stroke, the worse for the engine when the up-stroke was to be performed. For upon the readmission of steam into the cylinder—now severely chilled by the cold injection—much time and much steam would be consumed in merely making head against the wintry temperature within. Here, then, was as pretty a problem as could well be imagined. For one part of the process, it was desirable that the cylinder should be rendered excessively hot; for the other, excessively cold. In order to the up-stroke, the cylinder should be kept not lower than 212°; in order to the down-stroke, not higher than 100°. And to make the matter more perplexing, it was essential to the efficiency of the engine that these transitions from a tropical to an arctic climate should be brought about with considerable rapidity. It seemed in fact as if Hot and Cold, those ancient champions fierce, must needs be shut up in the same cylinder, and made, in some way or other, to forget their old feud and work in harmony.

At first, Watt appears to have thought, that, as the saving of fuel was a cardinal consideration in all questions of steam economy, it would be safest to take part with the champion heat; and accordingly he tried a great number of experiments to ascertain how the cylinder might be best defended against cold—during which experiments, it is worthy of remark, he stumbled upon the doctrine of *latent* heat, without any knowledge of Dr Black's previous discovery of the same principle. But, early in the year 1765, a lucky conception flashed through his brain. *Suppose that, instead of attempting to condense the vapour in the cylinder, this part of the process were effected in a separate vessel?* Steam, being an elastic substance, would rush into any cavity which might be opened to it, and there it might be reduced to water without damaging the temperature of the rest of the apparatus.

The spots where great discoveries are achieved ought to be held in perpetual respect. Watt has himself told us where this new thought came into his mind. One Sunday afternoon, as he was taking a stroll on the Green of Glasgow, the notion of a separate condenser flashed upon him. He perceived in an instant that he had grasped a clue which would lead him to the point which he had so long been labouring to reach. Great was his joy. A day or two afterwards Professor Robison, who had often conversed with Watt on scientific subjects, and particularly on the question of steam, happened to visit him. On entering the parlour, he found the great mechanician sitting before the fire with a little tin cistern on his knee, which he was examining attentively. Ignorant of the discovery just effected, Robison began to talk about steam, when Watt interrupted him by exclaiming briskly, "You need not fash yourself any more about that, man; I have now made an engine that shall not waste a particle of steam. It shall all be boiling hot!" Robison naturally put some questions with a view to elicit the secret; but the inventor, pushing the tin apparatus under the table with his foot, answered him rather dryly; and the querist was afraid to press for an explanation, knowing that he had offended Watt by revealing some little contrivance only a few days previously.

The condenser, though the chief and most distinctive, was not the only improvement made by Watt on the steam-engine. Thought after thought was added—organ was piled up on organ—until, in his hands, it was shaped into the grandest cluster of contrivances ever produced by man. First of all, as the steam was now to be condensed in a separate vessel, and as the injected water and accompanying air would go on collecting there, it was obvious that the condenser would soon attain a plethoric condition, utterly fatal to the production of the requisite vacuum in the cylinder. To prevent this evil, Watt hit upon the expedient of employing an *air-pump* to be worked by the engine itself, stroke for stroke with the piston, so that the condenser should be regularly cleared of its contents or kept in a state of due depletion. And in order that the separate vessel might be prevented attaining a temperature inconsistent with its duties, this part of the apparatus was immersed in a cistern of water, and a pump attached to the engine to feed the cistern with the cool fluid.

Another brilliant improvement was that of using steam *expansively*. According to old Hesiod, the half is often better than the whole. According to James Watt, one-fourth may be more serviceable than the entirety. He discovered that if, instead of allowing the steam to pour into the cylinder during the whole ascent of the piston, the supply was cut off when a quarter only of each beat was effected, the remainder might be accomplished by the elasticity of the vapour alone,—a discovery which necessarily led to an immense saving of steam and fuel.

The next step was one of a still more brilliant description.

It converted the steam-engine from a single-acting into a *double*-acting machine. Why, thought Watt, should not the process of forming a vacuum in the space beneath the piston to compel its descent, be repeated in the space above the piston to compel its ascent? Why not admit the steam alternately above and below, so that its elastic force should be brought to bear upon the piston during the whole of its travels from the commencement to the conclusion? The principle once perceived, the rest was with him a matter of mere mechanical detail; and, in 1783, he had a machine constructed upon the double-acting plan—thereby inaugurating what may be called the age of steam-power.

Many other devices for the improvement of his favourite engine issued from Watt's prolific brain; as, for instance, the parallel motion, the governor, the sun and planet wheels. But dismissing these—and waiving, besides, all mention of the improvements made by him in valves, pistons, boilers, and furnaces—it is enough to say that Watt did for the steam-engine something like what Augustus did for Rome. After finding it a clumsy, imperfect, intermitting machine, fit for little else but to serve as a drawer of water, he left it the monarch of machines—a splendid engine, governing itself with extraordinary precision, and capable of performing every kind of work with the strength of a giant, and yet with the docility of a child. Certainly, if there is any one to whom the thanks of mankind should be voted for services in the department of mechanical science, it is—JAMES WATT.

Adapted from the British Quarterly Review.

CIRCULATION OF THE BLOOD.

THE manner in which the bloodvessels are disposed in the human body bears some resemblance to the arrangement of the pipes by which a great city is supplied with water. London is, in a great measure, supplied by means of what we may call an engine contrived for the purpose of distributing the water of the New River through the city.

Large trunks are carried from this engine in different directions; smaller pipes branch out from these trunks into streets, lanes, and alleys; still smaller pipes issue from the branch pipes, and convey the water into private houses. These water-pipes may represent the *arteries* which carry the blood from the heart to the extremities of the body.

But in the human body another contrivance was necessary. The citizens of London may use the water or waste it as they please; but the precious fluid conveyed by the arteries to the ends of the fingers must be returned to the heart; for on its unceasing circulation our health depends. In order to effect this purpose, another set of pipes is prepared, called *veins*, which, joining the extremities of the arteries, receive the blood from them, and carry it back again to the heart. The veins present the same general appearance as the arteries, except that they have valves at short intervals all along their course; but as the office of the arteries is to distribute the blood, so that of the veins is to collect it. Through them it flows back to the heart in a manner just the reverse of that in which it sets out; the minute veins unite in larger branches, the larger branches unite in still larger trunks, till the collected blood is at length poured into the heart through one opening.

The engine that works this curious machinery is the *heart*. The heart is composed of four cavities. Like other muscles, it has the power of contracting; and when it contracts, the sides of its cavities are squeezed together, so as to force out any fluid which it may at that moment contain. This purpose being effected, the fibres relax, the heart once more becomes hollow, and as it dilates, the blood pours into the cavities from the large vein which brings it back to the heart. The next contraction forces the blood into the arteries,—the quantity thus impelled being always equal to that which has just been received; and thus this wonderful organ goes on, alternately contracting and dilating itself, *four thousand* times in an hour. The two larger cavities of the heart, which send out the blood to the arteries, are called *ventricles;* the two smaller, which receive it from the veins, *auricles*. The two great arteries which issue from the heart are furnished with valves which play easily forward, but do not admit the blood to return to the heart.

In all this there is abundant evidence of wise contrivance. The blood, in going out from the heart, is continually passing from wide tubes into those which are narrower; in coming back, it passes from narrow vessels into wider; consequently, it presses the sides of the arteries with greater force than it presses the coats of the veins. To prevent any danger from this difference of pressure, the arteries are formed of much tougher and stronger materials than the veins. This is one difference between the two; there is another still more strikingly illustrative of the care of the Great Artificer. As a wound in the arteries, through which the blood passes with such force from the heart, would be more dangerous than a wound in the veins, the arteries are defended, not only by their stronger texture, but by their more sheltered situation. They are deeply buried among the muscles, or they creep along grooves made for them in the bones. The under side of the ribs is sloped and furrowed, to allow these important tubes to pass along in safety; and in the fingers, which are liable to so many casualties, the bones are hollowed out on one of their surfaces like a scoop. Along this channel the artery runs in such security that you might cut your finger across to the bone without doing it any injury. MRS HACK.

PROCESS OF NUTRITION.

THE mode in which the body is nourished is well deserving of your attention. There are two sets of organs devoted to this object—those which perform the functions of circulation and respiration, and those which are concerned in the preparation of the food, and in nutrition. The former are situated in a cavity called the chest or thorax; the latter in a cavity beneath, called the abdomen. The chest is occupied principally by the heart and the lungs; the abdomen by the *stomach*, the intestines, the liver, the spleen, and the *pancreas or sweetbread*. These two cavities are separated by a partition called the diaphragm or midriff, which is partly of a fleshy and partly of a membranous nature, and readily gives way, by its laxity, to the alternate expansion and contraction of the chest in the action of breathing, to which its muscular power eminently contributes.

The first action to which the food is subject is *mastication* or chewing; and, for this purpose, man and most other animals are provided with teeth, which differ in their nature, according to the habits of the animal, and the particular description of food which is intended to nourish it. During the action of chewing, the food is mixed with the *saliva* or *spittle;* it is then carried backwards, and thrown into the *pharynx*, which is a sort of pouch in the back part of the mouth; from which it is made to descend, by the action of the muscles of the pharynx, into the *æsophagus* or *gullet*, at the extremity of which is the *stomach*, into which the food is deposited.

The *stomach* in man is a membranous bag, not very unlike the shape of the bagpipe, lying across the body, and having two openings; the upper towards the left side, by which it receives food from the gullet, called the *cardia*, from its supposed sympathy with the heart; and the lower, on the right side, called the *pylorus*, by which the food passes on to the intestines. Between the coats of the stomach are various small glands, that secrete and pour into it a fluid called *gastric* juice, which dissolves the substances taken into the stomach, converts them into a grayish, pulpy mass, called *chyme*, and thus fits them for becoming nourishment. When the food has undergone, to a sufficient extent, the change which it is meant to suffer in the stomach, an action of the muscular coats of this organ takes place, by means of which it is passed through the pylorus, or lower orifice, into the intestines. But care is taken that it does not quit the stomach too rapidly for the necessary changes to be made in it. This is effected by the pylorus being contracted so as to resemble a valve, and made to act as a strainer, so that only fluid or pulpy food can pass through the opening, half-digested solid matters being rejected by it.

The *intestines*, which consist of six different parts, bear a considerable resemblance to the stomach in their structure. By means of their muscular coats, the food, after passing through the pylorus, is gradually carried downwards, by a sort of gentle contractile motion, which is technically called the *peristaltic* motion of the intestines. Next to the stomach, the most important change which the food undergoes is in the first intestine, where the bile, which is a bitter juice secreted by the liver, and the pancreatic juice, which is a fluid resembling saliva, secreted by the pancreas, are added to it; but, over the whole course of the canal, fluids are poured into it, for facilitating its conversion into nourishment. The food thus so altered in its nature, is now called *chyle*, a fluid which somewhat resembles milk in appearance.

Such is the process of *digestion*. It consists of two operations—one occurring in the stomach, by which the food is converted into chyme; the other in the bowels, by which it is converted into chyle. The next process is *absorption*. Over the whole interior of the intestines minute vessels, called *lacteals*, open for the purpose of taking up the chyle. Uniting into larger vessels, they pass through the structures which are called the *mesenteric glands*, and at last join in one large trunk, which is called at its commencement the receptacle of the chyle, and in its continuance the *thoracic duct*. This forms a tortuous canal, several inches in length, and about the thickness of a quill. It lies close to the spine, and some of the large bloodvessels, and, ascending to the upper part of the chest, delivers its contents into a large vein near the heart, called the *left subclavian;* and its contents then form a part of the general mass of the blood.

But the blood which is thus mixed with the chyle is not at once fitted to nourish the body; it must pass through the *lesser* circulation. The *greater* circulation—that is, the mode in which the blood is transmitted from the heart to the different parts of the body by the arteries, and returned by the veins to be again circulated—has been explained in the preceding lesson. But it is to be observed, that there is an intermediate or *lesser* circulation through the lungs. The chyle enters the veins, and the veins convey the blood to the right side of the heart, whence it is carried through the lungs. It is then brought back to the left side of the heart, and forthwith transmitted by the arteries all over the body, to be brought back by the veins, and to be continually subject to a repetition of the same career. There is thus a sort of double circulation—one side of the heart circulating the blood through the lungs, the other over the body. The necessity for the lesser circulation arises from this, that blood is not fitted for the support of the system when it is first received into the heart with the recent addition of chyle. It is only blood of a florid red or scarlet colour, such as is found in the arteries, that is adapted to the nutritive purposes of the system; but that which is contained in the veins is of a dark or Modena red, and therefore its nature must be ameliorated before it can be of any value. This is effected by passing it through the vessels of the lungs, where it is freely exposed to the action of the atmosphere during the process of respiration, and is in this way rendered fit to be assimilated. From the lungs it returns to the heart florid or proper blood; and it is then circulated by the arteries, furnishing the materials for the growth of parts, and for the formation of the various secretions of the body. *Compiled.*

BATTLE OF THE BALTIC.

Of Nelson and the North,
Sing the glorious day's renown,
When to battle fierce came forth
All the might of Denmark's crown,
And her arms along the deep proudly shone;
By each gun the lighted brand
In a bold determined hand,
And the prince of all the land
Led them on.

Like leviathans afloat,
Lay their bulwarks on the brine;
While the sign of battle flew
On the lofty British line:
It was ten of April morn by the chime:

As they drifted on their path,
There was silence deep as death;
And the boldest held his breath
For a time.

But the might of England flushed
To anticipate the scene;
And her van the fleeter rushed
O'er the deadly space between.
"Hearts of oak!" our captains cried; when each gun
From its adamantine lips
Spread a death-shade round the ships,
Like the hurricane eclipse
Of the sun.

Again! again! again!
And the havoc did not slack,
Till a feeble cheer the Dane
To our cheering sent us back:—
Their shots along the deep slowly boom;
Then ceased—and all is wail,
As they strike the shattered sail;
Or, in conflagration pale,
Light the gloom.

Now joy, Old England! raise
For the tidings of thy might,
By the festal cities' blaze,
While the wine-cup shines in light;
And yet, amidst that joy and uproar,
Let us think of them that sleep,
Full many a fathom deep,
By thy wild and stormy steep,
Elsinore!

CAMPBELL.

WATERLOO.

THERE was a sound of revelry by night,
And Belgium's capital had gathered then
Her Beauty and her Chivalry, and bright
The lamps shone o'er fair women and brave men;

A thousand hearts beat happily; and when
Music arose with its voluptuous swell,
Soft eyes looked love to eyes which spake again,
And all went merry as a marriage-bell;
But hush! hark! a deep sound strikes like a rising knell!

Did ye not hear it?—No; 'twas but the wind,
Or the car rattling o'er the stony street;
On with the dance! let joy be unconfined!
No sleep till morn, when Youth and Pleasure meet
To chase the glowing Hours with flying feet—
But, hark!—that heavy sound breaks in once more,
As if the clouds its echo would repeat;
And nearer, clearer, deadlier than before!
Arm! Arm! it is!—it is!—the cannon's opening roar!

Ah! then and there was hurrying to and fro,
And gathering tears, and tremblings of distress,
And cheeks all pale, which but an hour ago
Blushed at the praise of their own loveliness;
And there were sudden partings, such as press
The life from out young hearts, and choking sighs
Which ne'er might be repeated; who could guess
If ever more should meet those mutual eyes,
Since upon night so sweet such awful morn could rise!

And there was mounting in hot haste: the steed,
The mustering squadron, and the clattering car,
Went pouring forward with impetuous speed,
And swiftly forming in the ranks of war;
And the deep thunder peal on peal afar;
And near, the beat of the alarming drum
Roused up the soldier ere the morning star;
While thronged the citizens with terror dumb,
Or whispering, with white lips—"The foe! They come! they come!"

And wild and high the "Cameron's gathering" rose!
The war-note of Lochiel, which Albyn's hills
Have heard, and heard, too, have her Saxon foes:—
How in the noon of night that pibroch thrills,
Savage and shrill! But with the breath which fills
Their mountain-pipe, so fill the mountaineers
With the fierce native daring which instils

The stirring memory of a thousand years,
And Evan's, Donald's fame rings in each clansman's ears!

And Ardennes waves above them her green leaves,
Dewy with nature's tear-drops, as they pass,
Grieving, if aught inanimate e'er grieves,
Over the unreturning brave,—alas!
Ere evening to be trodden like the grass
Which now beneath them, but above shall grow
In its next verdure, when this fiery mass
Of living valour, rolling on the foe
And burning with high hope, shall moulder cold and low.

Last noon beheld them full of lusty life,
Last eve in Beauty's circle proudly gay,
The midnight brought the signal-sound of strife,
The morn the marshalling in arms,—the day
Battle's magnificently stern array!
The thunder-clouds close o'er it, which when rent
The earth is covered thick with other clay,
Which her own clay shall cover, heaped and pent,
Rider and horse,—friend, foe,—in one red burial blent!

BYRON.

ENGLISH VERSIFICATION.

THE chief delights of poetry are those which it supplies to the mind. But it has other attractions. Next to its language is the tone of its voice. It makes love to the ear, and wins it with music. Certain passages possess a beauty altogether unconnected with their meaning. The reader is conscious of a strange, dreamy sense of enjoyment, as of lying upon warm grass in a June evening, while a brook tinkles over stones in the glimmer of trees. How deep is the magic of sound may be learned by breaking some sweet verses into prose. The operation may be compared to gathering dewdrops, which shine like jewels upon the flower, but run into water in the hand.

Of all the measures in which imagination takes its pastime, the heroic line of Milton and Shakspeare is the most rich and changeful. Milton played on his metre like his organ. He brings out, with a daring finger, every grand and various note—with wonderful effect, striking a momentary crash of discord into the full swell of the music. He disregards syllables. A poet, not unworthy to criticise him, quotes the verses in which Death threatens Satan at the gates of Hell—

"Back to thy punishment,
False fugitive! and to thy speed add wings,
Lest with a whip of scorpions I pursue
Thy lingering, or with one stroke of this dart,
Strange horror seize thee, and pangs unfelt before,"—

and remarks, "The hand of a master is felt through every movement of this sentence, especially towards the close, where it seems to grapple with the throat of the reader; the hard, *staccato* stops, that well-nigh take the breath, in attempting to pronounce, 'Or with one stroke of this dart,' are followed by an explosion of sound in the last line like a heavy discharge of artillery."—If Shakspeare be studied with equal attention, the whole power and compass of the English language will be understood. Perhaps it is susceptible of no inflection of harmony—not even the low thrill of the flageolet,—which is not brought out in the passionate or familiar tones of its imperial master.

The rhyming couplet may claim the second rank. Dryden took the tinkle from the chime by his artful and various pauses. At once majestic and easy, with the trumpet peal and the warble of the flute, he fills and entrances the ear. The mellifluence of Pope, as Johnson called it, has the defect of monotony. Exquisite in the sweet rising and falling of its clauses, it seldom or never takes the ear prisoner by a musical surprise. Pope has no variations. The tune is delicate, but not natural. It reminds us of a bird, all over brilliant, which pipes its one lay in a golden cage, and has forgotten the greenwood in the luxury of confinement. But Dryden's versification has the freedom and the freshness of the fields. Running through his noblest harmonies, we catch, at intervals, that rude sweetness of a Scottish air which he himself heard in Chaucer. This is a great charm. He preserved the simple, unpremeditated graces of the earlier couplet, its confluence and monosyllabic close, while he added a dignity and splendour unknown before.

The stanza to which Spenser has given a name combines the advantages of the blank verse with the graces of the rhymed; and, as employed by Spenser himself, it is unequalled for breadth, richness, and sound. It is marked, moreover, by a romantic wildness, which is singularly appropriate to the visionary temper of his great poem. The lingering, dying fall of the closing Alexandrine suits well the antique style, and the serious light of the verse. As the music rolls down the shadowy canto—which the cloud of allegory and the beams of fancy fill with a balmy twilight—we recall to our memory the anthem in a gorgeous chapel, when it sweeps along the branching roof, and trembles round the decorated pinnacles, and sighs among the glimmering stonework and the fading canopies, until every pillar and leaf are

"Kissed
By sound, or ghost of sound, in mazy strife."

It would be like reckoning up the notes of the wood in spring, to dwell upon the pleasures afforded to the ear by that linked sweetness, which gives the title of "lyrical" to the dancing numbers of Cowley, and the buoyant Masques of Milton and Jonson. While the laboured efforts of their genius are honoured and surveyed, the gayer language of their fancy is ever on the tongue. *Paradise Lost* is laid up in cedar; but *L'Allegro* is a household word.

It was a saying of Shenstone, and experience confirms it, that the lines of poetry, the periods of prose, and even the texts of Scripture, most frequently recollected and quoted, are those which are felt to be pre-eminently musical. The simplest rhythm is the softest, and the most familiar is the dearest. The compositions to which we return with affecting frequency owe their interest to the cadence scarcely less than to their imagery. Take the following specimen, which has the warble and the pathos of the nightingale—it is from Coleridge:—

" Flowers are lovely; Love is flower-like;
  Friendship is a sheltering tree;
Oh, the joys that came down shower-like,
  Of Friendship, Love, and Liberty,
      Ere I was old!
Ere I was old! Ah, woeful *Ere!*
Which tells me, Youth's no longer here!
O Youth! for years so many and sweet,
  'Tis known that thou and I were one;
I'll think it but a fond conceit—
  It cannot be that thou art gone!
The vesper bell hath not yet tolled,
And thou wert aye a masker bold!
What strange disguise hast now put on,
To make believe that thou art gone?
I see these locks in silvery slips,
  This drooping gait, this altered size;
But spring-tide blossoms on thy lips,
  And tears take sunshine from thine eyes!
Life is but thought; so think I will
That Youth and I are housemates still."

WILLMOT.

HEBREW METRE.

EVERY observant reader of the Hebrew poets must have remarked the symmetrical construction of their periods, and the nice correspondence in sentiment and phraseology between the two members of which a period is usually composed. This correspondence is called *Parallelism;* and it assumes a considerable variety of forms. Sometimes the members correspond exactly—the second being responsive to the first, both in sense and in grammatical structure—thus:

" He hath clothed me with the garments of salvation,
He hath covered me with the robe of righteousness,
As a bridegroom decketh himself with ornaments,
And as a bride adorneth herself with her jewels."

Isaiah, lxi. 10.

Sometimes there is a double correspondence:

" And they shall build houses, and inhabit them;
And they shall plant vineyards, and eat the fruit of them.

They shall not build, and another inhabit;
They shall not plant, and another eat."—*Isaiah*, lxv. 21,22.

Sometimes the correspondence is one of contrast:

"For the mountains shall depart,
And the hills be removed;
But my kindness shall not depart from thee,
Neither shall the covenant of my peace be removed."
Isaiah, liv. 10.

And there are also parallelisms where the correspondence consists merely in the similar form of construction:

"How goodly are thy tents, O Jacob!
And thy tabernacles, O Israel!
As the valleys are they spread forth,
As gardens by the river's side,
As the trees of lign-aloes which the Lord hath planted,
And as cedar-trees beside the waters."
Numbers, xxiv. 5, 6.

Now, strange as this parallelistic arrangement may sound to modern ears, no form of verse could have been framed more entirely accordant with the nature and purposes of Scripture poetry. Among the Hebrews, poetry was always united to music; and as the music was performed in alternate chorus—one choir repeating and prolonging the strain of the other—the poet's hemistichs required to correspond in an alternation of parts. Its adaptation to the ancient method of singing is, however, the least of the recommendations of this peculiar metre. Parallelism has enabled the Hebrew poems to resist the darkness which time brings over other writings, and to repair the losses which the negligence of transcribers has occasioned. While every sentence has its correspondent and equivalent member, the sense which in one is obscured, in the other remains perfect; or if an error should have crept into each, it is impossible that they should be parallel errors at once corresponding to each other and to the general structure of the context. A conjectural reading, too, has much more certainty here than in other writings, since the conjecture is checked by the condition that the conjectural reading must suit both members of the sentence.

How congruous is such a structure to the purpose of writings intended for the religious instruction of all ages! We may trace in it the same wise design as in the structure of the human body; for, from the frame being double, the loss of one eye does not altogether deprive us of sight, nor the loss of one limb, of the power of moving.

But has not Parallelism too much the air of rhetorical artifice, to be in keeping with the unstudied simplicity of the Scripture style? On a cursory glance it has. But we are misled here, as in many other cases, by our preconceived notions. We make our own system of versification the standard of comparison; and because another system is dissimilar to ours, we rashly pronounce it unnatural and artificial. Parallelism, so far from being a refinement of art, is really the primordial and simplest form of metrical composition. In the earliest stages of language—before syllables admitted of being accurately scanned and measured—a symmetrical arrangement of ideas and words was the only method of distinguishing poetry from prose, and therefore the only form of poetic verse. We learn from the specimens preserved in the Pentateuch, that the poetry of the Antediluvians, and also of the Edomites and Amorites, was cast in the parallelistic mould; and travellers inform us that a similar structure characterizes the rude verses of most modern semi-barbarous tribes. Even in languages which employ a versification of measured syllables, some vestiges may be discerned of an older style of composition closely resembling the Hebrew model. The verses of the Grecian oracles are occasionally parallelistic; and even some of the choicest Greek metres—for example, the Elegiac and the Sapphic—are indebted for their charm, as much to the symmetrical proportion of their alternate parts as to their fine rhythmical intonation: while in modern tongues, those correspondences of sound which we call Rhyme, may be traced, for their origin, to the uniform movement of the parallelism.

It is not, then, the sweet singers of Israel, but the poets of other nations, that have innovated on the system of nature, and adopted the fastidious refinements of art. The truth is, that parallelism, instead of being an artifice of rhetoric, is one of those figures of speech in which strong feeling instinctively and unconsciously clothes itself. Strong feeling is never satisfied with the simple assertion of a sentiment. It delights to express it again and again, and to recast it in a series of symmetrical forms. In resorting to the parallelism, the Hebrew poets only obeyed the promptings of nature; and it is just because they wrote from the spontaneous impulses of the heart, that the figure is in their pages invariably beautiful. In the hands of an affected or artificial writer, this method of ceaseless reiteration would inevitably become languid and monotonous. But the Hebrew Muse is never tiresome. In repeating the same idea in different words, she seems as if displaying a fine opal, that discovers fresh beauty in every new light to which it is turned. Her amplifications of a given thought are like the echoes of a solemn melody; her repetitions of it, like the landscape reflected in the stream. And while her questions and responses give a life-like effect to her compositions, they remind us of the alternate voices in public devotion, to which they were adapted, and help us to connect with the pleasures of taste the higher pleasures of piety.

THE TEMPLE OF FAME.

But in the centre of the hallowed choir,
Six pompous columns o'er the rest aspire;
Around the shrine itself of Fame they stand,
Hold the chief honours, and the fane command.
High on the first, the mighty Homer shone;
Eternal adamant composed his throne;
Father of verse! in holy fillets drest,
His silver beard waved gently o'er his breast:
Though blind, a boldness in his looks appears;
In years he seemed, but not impaired by years.
The wars of Troy were round the pillar seen:
Here fierce Tydides wounds the Cyprian Queen;
Here Hector, glorious from Patroclus' fall,
Here dragged in triumph round the Trojan wall.

Motion and life did every part inspire,
Bold was the work, and proved the master's fire.
  A golden column next in rank appeared,
On which a shrine of purest gold was reared;
Finished the whole, and laboured every part,
With patient touches of unwearied art:
The Mantuan there in sober triumph sate,
Composed his posture, and his look sedate;
On Homer still he fixed a reverent eye,
Great without pride, in modest majesty.
In living sculpture on the sides were spread
The Latian wars, and haughty Turnus dead;
Elissa stretched upon the funeral pyre,
Æneas bending with his aged sire;
Troy flamed in burning gold, and o'er the throne
Arms and the Man in golden ciphers shone.
  Four swans sustain a car of silver bright,
With heads advanced, and pinions stretched for flight:
Here, like some furious prophet, Pindar rode,
And seemed to labour with the inspiring god:
Across the harp a careless hand he flings,
And boldly sinks into the sounding strings.
The figured games of Greece the column grace,
Neptune and Jove survey the rapid race;
The youths hang o'er their chariots as they run;
The fiery steeds seem starting from the stone:
The champions in distorted postures threat;
And all appeared irregularly great.
  Here happy Horace tuned the Ausonian lyre
To sweeter sounds, and tempered Pindar's fire;
Pleased with Alcæus' manly rage to infuse
The softer spirit of the Sapphic Muse.
The polished pillar different sculptures grace;
A work outlasting monumental brass.
Here smiling Loves and Bacchanals appear;
The Julian star, and great Augustus here:
The Doves, that round the infant Poet spread
Myrtles and bays, hang hovering o'er his head.
  These massy columns in a circle rise,
O'er which a pompous dome invades the skies:
Scarce to the top I stretched my aching sight,
So large it spread. and swelled to such a height.

Full in the midst proud Fame's imperial seat
With jewels blazed magnificently great.
When on the goddess first I cast my sight,
Scarce seemed her stature of a cubit's height;
But swelled to larger size, the more I gazed,
Till to the roof her towering front she raised.
With her, the temple every moment grew,
And ampler vistas opened to my view:
Upward the columns shoot, the roofs ascend,
And arches widen, and long aisles extend.
Such was her form, as ancient Bards have told,
Wings raise her arms, and wings her feet infold;
A thousand busy tongues the goddess bears,
A thousand open eyes, a thousand listening ears.
Beneath, in order ranged, the tuneful Nine
(Her virgin handmaids) still attend the shrine;
With eyes on Fame for ever fixed, they sing;
For Fame they raise the voice, and tune the string:
With Time's first birth began the heavenly lays,
And last, eternal, through the length of days.

POPE.

THE WINDS.

THE ready expansibility of air by heat gives rise to those rapid and noisy aerial currents which we call the Winds. When any one part of the atmosphere is more heated than the rest, that part is rarefied, and its greater lightness causes it to rise. When this happens, there necessarily follows a motion of the surrounding air towards that part, in order to restore the equilibrium; this spot, therefore, receives wind from every quarter, until the equilibrium is restored, when the movement ceases, and the air again becomes calm.

In the temperate regions of the earth the winds are very variable, except along the seaboards, where a certain regularity prevails. On the seashore there is generally, at least during summer, a gentle sea-breeze setting in on the land in *the evening, to* restore the equilibrium which had been disturbed by radiation from the heated surface of the land during the day; and, on the other hand, when night has cooled the land and condensed the superincumbent air, that air flows back towards the sea at the approach of morning, producing what is called the land-breeze.

But within and near the tropics, a much greater regularity prevails; of which the *trade-winds* and the *monsoons* furnish beautiful examples. In the torrid zone, where the heat is greatest, the air is necessarily more rarefied and lighter than in any other part of the globe: it consequently ascends; while the colder air continually flows from the poles to restore the equilibrium. This motion of the air would produce a constant north wind to the inhabitants of the northern hemisphere, a south wind to those of the southern hemisphere, and continual storms at the equator, did not the diurnal rotation of the earth modify its direction. The atmosphere accompanies the earth in its diurnal motion, and consequently travels with greater or less velocity as it is nearer the equator or more distant from it. When, therefore, the air flows from the north or south to restore the atmospherical equilibrium at the equator, this air, not having acquired the velocity of the equatorial regions, cannot keep pace with the earth, which, travelling faster, passes through it; and as the earth moves from west to east, its motion through the air produces an easterly wind. In this way, the combination of the winds from the north and south with the motion of the earth forms what are called the *trade-winds*—the northern wind being deflected into a constant north-east wind; the southern wind being deflected into a regular south-east wind. These winds extend to about thirty degrees on each side of the equator; and they furnish, it may be remarked, a decisive physical proof of the reality of the earth's rotation.

In the Indian Ocean—which has not the vast expansion of the Pacific and Atlantic, but is rather a great gulf nearly surrounded by huge continental masses—the trade-wind changes into a sort of double semi-annual wind, blowing regularly six months in one direction, and six months in another. This is the *monsoon*, and it is to be accounted for in much the same way as the land and sea breezes mentioned above.

While Africa, south of the equator, receives the vertical rays of the summer sun in December, January, and February, Southern Asia, on the north of the equator, and the neighbouring seas are feeling the low temperature of winter. The air rushes in from the colder regions of India and Upper Asia towards the warmer regions of Southern Africa, and the trade-wind is transformed into a north-east wind, which blows as long as this difference of temperature lasts. The reverse takes place when India and Asia are heated by the burning sun of the northern summer, and Africa is cooled by the southern winter; a south-west wind then blows. Hence it is that, in place of a constant current setting from east to west, the relative position of the lands, combined with the action of the seasons, gives rise to two periodical winds,—the monsoon of the north-east, which blows from October to April, and the monsoon of the south-west, which blows from April to October. In the southern part of the Indian Ocean, which is not under the influence of the lands, the south-east trade-wind blows quite regularly through the whole year. The transition, or breaking up of the monsoons—being dependent on the course of the sun's movement from one hemisphere to the other—does not occur at the same period in places situated under different latitudes; it is usually attended by storms and hurricanes, indicating a general disturbance of the atmosphere.

It is almost unnecessary to dwell on the useful and agreeable effects of which winds are productive. They purify our atmosphere, by keeping up a perpetual agitation in it; they dissipate the miasmata exhaled from marshes and stagnant water; they raise and transport the clouds destined to fertilize the ground by means of rain. Millions of seeds, furnished with their little pinions, ride upon the wings of the wind, and spread afar the empire of vegetation. The ingenuity of man has made a lever of the winds, which, when applied to machinery, spares him an immensity of toil. If the ocean is the highway of our globe, winds are the in*defatigable* coursers which rapidly transport our ships from *pole to pole.*

Compiled.

A SULTRY DAY.

IT is a sultry day. . . . The flowers are sick
Under the potent fervour; the tall maize
Rolls up its long green leaves; the clover droops
Its tender foliage, and declines its blooms.
But far in the fierce sunshine tower the hills,
As if the scorching heat and dazzling light
Were but an element they loved. Bright clouds,—
Motionless pillars of the brazen heaven,
Their bases on the mountains, their white tops
Shining in the far ether—fire the air
With a reflected radiance, and make turn
The gazer's eye away. For me, I lie
Languidly in the shade, where the thick turf,
Yet virgin from the kisses of the sun,
Retains some freshness, and I woo the wind
That still delays its coming. Why so slow,
Gentle and voluble spirit of the air?
Oh, come and breathe upon the fainting earth
Coolness and life! Is it that in his caves
He hears me? See, on yonder woody ridge,
The pine is bending his proud top, and now
Among the nearer groves, chestnut and oak
Are tossing their green boughs about. He comes!
Lo, where the grassy meadow runs in waves!
The deep distressful silence of the scene
Breaks up with mingling of unnumbered sounds
And universal motion. He is come,
Shaking a shower of blossoms from the shrubs,
And bearing on their fragrance; and he brings
Music of birds, and rustling of young boughs,
And sound of swaying branches. The green herbs
Are stirring in his breath; a thousand flowers
Nod gaily to each other; glossy leaves
Are twinkling in the sun, as if the dew
Were on them yet; and silver waters break
Into small waves, and sparkle as he comes.

BRYANT.

MOTIONS OF THE EARTH, MOON, AND PLANETS.

Tutor. Charles.

T. Now that you have finished your perusal of the little treatise on Astronomy, I wish to ask you a few questions respecting its contents. You recollect the names and nature of the different heavenly bodies?

C. They are divided into *fixed stars*, *planets*, and *comets*. The fixed stars are supposed to be suns; the planets, inhabited worlds like our own; and the comets — their nature is not so well understood — they are generally remarkable, however, for their *luminous tails*, the velocity of their motions, and the eccentricity of their orbits.

T. What of the motions of the planets?

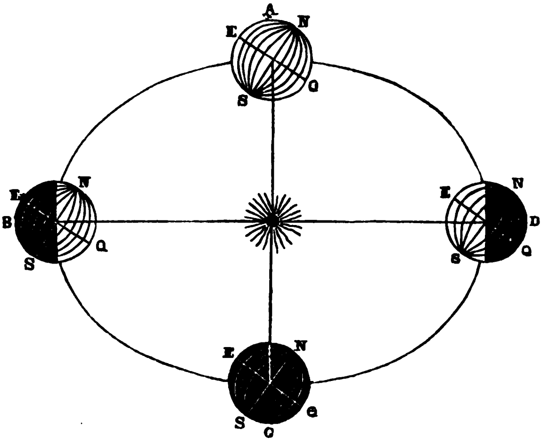
C. The planets have each two motions, a *diurnal*, round their own axis, and an *annual*, round the sun; the former causes the vicissitude of day and night, and the latter the succession of the seasons.

T. Were the axis of the earth perpendicular to its orbit, would these vicissitudes occur exactly as at present?

C. In that case there could be no variety in the length of the day and night, and very little, if any, change of season.

T. In its motion round the sun, the axis of the earth is always inclined at the same angle to the plane of its orbit— how does this account for the difference of the length of the days, and for the seasons?

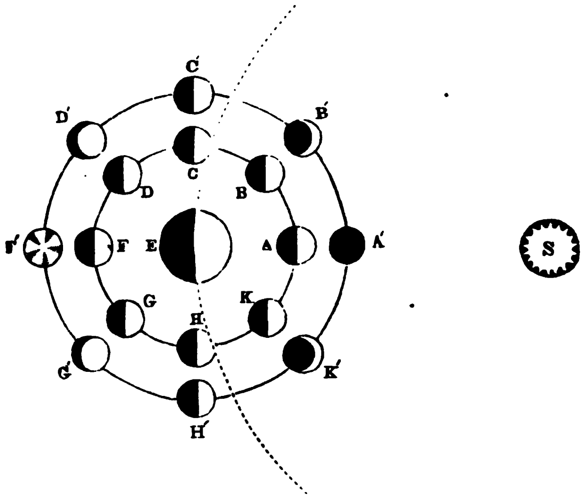
C. At the spring equinox both poles are equidistant from the sun, and the solar rays fall directly on the equator; the inhabitants of both temperate zones are in the same state as to temperature, so are the inhabitants of both frigid zones; and the length of the day and night is necessarily equal all over the world. But when the earth reaches that part of her orbit when it is midsummer to us and to all the inhabitants of the northern hemisphere, the north pole is turned towards the sun, the south pole turned from him, and the solar rays fall directly upon the northern tropic. There is, consequently, continual day in the north frigid zone, long days and short nights in the north temperate, and total darkness in the south frigid zone. At the autumnal equinox, the earth is in nearly the same situation as at the vernal; and, at our mid-winter, the south pole is turned to the sun, and the north pole turned from it.



The Seasons.—N, S, north and south poles.—E, Q, the equator.—A, position of the earth at the spring equinox.—B, position at midsummer.—C, position at the autumnal equinox.—D, position at midwinter.

T. Now, give me, if you please, an equally distinct account of the phases of the moon.

C. When the new moon is first seen from the earth, she appears a slender crescent on the left of the sun, with the convex side turned towards him. As she recedes from the sun, the crescent gradually increases in breadth. When she has performed an eighth part of her revolution round the earth, she is said to be in her first octant, and appears a quarter-moon. In less than four days after this she is in her quadrature, and has the form of a half-moon. After the same interval of time, she reaches her second octant, and becomes gibbous, or exhibits an intermediate figure between half and full moon. In a few days, she assumes a form completely round, and is in opposition to the sun, and is seen upon the meridian at midnight. After this, she begins to decrease in size, and presents, in succession, but in an inverted order, precisely the same forms which she exhibited when on the increase, with this difference, that the side of the disc which was first illuminated now first disappears. In about eleven days after full moon, she is seen in the morning, on the right of the sun, in the shape of a thin crescent, with her convex side towards him as at first; and after this she gradually disappears. About six days afterwards, she reappears on the other side of the sun, and exhibits again the same changes.



Phases of the Moon.—S, the sun.—E, the earth.—A, B, C, D, F, G, H, K, the moon at successive points (octants) of her revolution, from A, new moon, to K, her last octant.—A′, B′, C′, D′, F′, G′, H′, K′, the corresponding phases or appearances of the moon in these her successive octants, as seen from the earth.

T. Of course, you have taken it for granted that these phases are owing to the moon's being an opaque body, and deriving her light from the sun. With such an accurate conception of the relative position of the sun, earth, and moon, you found, I presume, no difficulty in comprehending the doctrine of eclipses?

C. An eclipse of the sun is occasioned by the body of the moon being interposed between the sun and the spectator, and, consequently, can happen only when the moon is in conjunction, or at new moon. An eclipse of the moon is produced by the moon passing through the earth's shadow, and can, therefore, happen only when the moon is full, or in opposition to the sun.

T. But why, then, do not eclipses happen at every new and full moon?

C. This would be the case, if the moon's orbit coincided, or was in the same plane, with the earth's orbit; but as the moon's orbit is inclined to that of the earth at an angle of above 5°, it follows that the moon, earth, and sun, can only be in the same plane at the time of passing the nodes,—that is, when the two orbits cross each other. Now, the moon can be in the nodes only twice in the course of a revolution; consequently, she may perform a number of revolutions before she finds the sun exactly on that point of the ecliptic when she cuts it, or on the point immediately opposite; therefore, a *central* eclipse, either of the sun or moon, must occur very seldom. Partial eclipses must happen more frequently.

T. Are the sun and moon, as seen from the earth, always of the same apparent magnitude?

C. No. Both the sun and moon vary both in apparent magnitude and in apparent velocity; and when their apparent magnitude is greatest, their apparent velocity is also greatest. These appearances are easily explained. The earth and moon (and the same thing is true of all the planets) do not move in circular but in elliptical orbits; the sun is in one of the foci of the earth's orbit, and the earth is in one of the foci of the moon's orbit; consequently, the sun and moon are nearer, and, therefore, appear larger at one time than at another.

T. The planets Mercury and Venus are called *inferior*, and the planets Mars, Jupiter, Saturn, Herschel, and Neptune, *superior*, because the orbits of the former are within the orbit of the earth; and those of the latter without it. Do you remember any points of distinction between their apparent motions?

C. The inferior planets are always found in the immediate neighbourhood of the sun, the superior recede from him to all distances; the inferior are never seen in opposition, or on the meridian at midnight, the superior frequently; the inferior are observed occasionally to cross the sun's disc when in conjunction, the superior never. In one point, however, there is a remarkable agreement between the two; the apparent motion of all the planets is sometimes direct, sometimes retrograde, and sometimes stationary.

T. Are all these phenomena satisfactorily accounted for on the supposition that the planetary bodies move in orbits more or less circular round the sun?

C. Yes; and they can be explained on no other supposition. The fact, that the superior planets are seen in opposition, proves that the earth moves between them and the sun; and the fact, that the inferior planets are occasionally seen crossing the sun's disc, as plainly proves that they move between the earth and the sun. The change of apparent motion, too, is an equally convincing proof of their actual revolution round the sun; for the same appearances may be observed in an orrery, where a number of balls are made to revolve round a central body.

T. I doubt not you were very much interested in tracing the apparent motions of Venus, the morning and evening star.

C. They seemed, at first, somewhat complex; but, now that I understand the *real* motions, I have no difficulty with them: shall I describe them? About two months after her inferior conjunction, Venus begins to appear, in the gleam of the evening twilight, about 19° on the left of the sun. She continues to recede from him night after night, till her angular distance is about 47°; after which she begins to approach him again, and continues to move towards him till her angular distance is about 28°. She now appears to become stationary for a little, and afterwards commences a retrograde motion. In a few days, she is hid in his rays in the evening, and continues invisible about six weeks, when she is again seen in the morning on the other side of the sun, disengaging herself from his rays and retiring from him. She is now coming from her inferior conjunction, and is called the *morning star*. Appearances nearly the same occur until she comes again to her superior conjunction; after which she is again the *evening star*. The time she takes to perform an entire revolution is about eighteen months.

T. I shall not detain you longer; for I am already satisfied that you have perused the little treatise on Astronomy with attention and intelligence.

POPULAR ERRORS RESPECTING INDUSTRIAL LAWS.

1. MANY people are of opinion that the very unequal distribution of wealth, which we see everywhere around us, ought not to exist. There ought not, they think, to be some men with splendid mansions and equipages, while others have to live in hovels, and go barefooted. They would have the wealth of the rich so divided as to place rich and poor on a level—imagining that all classes would then be happy.

But this is an erroneous opinion. If the wealth of the country were equally divided among all the people, what would be the consequence? Why, the lazy and extravagant would cease to labour, and only consume until they got rid of their whole stock, and became as poor as ever; while, on the other hand, the industrious and frugal would continue to produce, thereby adding to their stock, and growing every day richer. In a short time, therefore, there would be as great diversity in the circumstances of the people as before; and thus, to say the least, the scheme of equalizing property would prove a failure. "But might not wealth be anew divided, and a second redistribution made?" This, instead of mending matters, would only make them worse. For, in such a case, the industrious and careful, knowing that their wealth would be taken from them as fast as they produced it, would no longer labour and save. There would be no encouragement for any one to work and save, and so all would become wretchedly poor.

It is quite proper that those who are not satisfied with their present share of wealth should try to increase it; but such increase is not obtainable by any forced redistribution of wealth,—it is obtainable only by means of industry and frugality. The artisan who wants to be better fed, and clothed, and lodged than he now is, should recollect how he got his present food, and clothing, and lodging. He got them by working and saving; and it is only by further working and saving that he can procure the higher conveniences and comforts which he now desires. Nor let him be discouraged. He may become, if he will, a more skilful workman than now, and thereby earn higher wages; he may become, if he will, more economical than now, and thereby save more money. It only requires a course of steady industry and frugality to enable him to rise to be a foreman and even a master. There are scores of rich capitalists in all our great towns, who began their career as workingmen.

2. Some who do not go the length of maintaining that an equal division of wealth is either practicable or desirable, are yet of opinion that the wealth of the few is so much taken away from the means of the many, and that the poor are, therefore, worse off because of the wealth of the rich. But this also is an error.

Does the wealth of the rich take anything away from the poor? It does not. The reason why any man is rich is, that either he or one of his ancestors has been more skilful, industrious, or provident than his neighbours, and so has been able to make a fortune. His wealth had no existence until he or his ancestors produced it: and how absurd to say that that can be taken away from the poor, which, but for the rich man's exertions, must have been a nonentity! Nay, the wealth of the rich, so far from taking anything away from the poor, invariably adds to the means and comforts of the poor. While making his fortune, the rich man gives employment and wages to many who would otherwise be without employment and wages; and after he has made it, he continues to spend it on necessaries and luxuries, which cannot be produced except by a continual disbursement of wages to those employed in their production. *Where there are no rich men, there can be no capital available for wages*; and experience proves that the poor are always worst off in countries where there is little or no capital.

3. Workmen err when they suppose, as they often do, that it is they who produce the capitalist's profit, and that they ought consequently to share in that profit. The labour of his workmen is only a *part* of that which makes the capitalist's profit. Their labour would avail but little in the absence of his superintendence or that of his foremen; nor could it avail at all, did he fail to provide the raw material. Nay, his very machinery (as in the case of a foundry or a cotton-mill) is quite as necessary as his workmen's labour to change the raw material into saleable goods. The machinery helps to make the profit as really as the men. Yet what would be said, if the maker of the machines, after having been paid for them, were to go to the capitalist and demand a share of the profit on the ground that he had helped to make it? Would not the capitalist be entitled to say to him, "You have been already paid for the machines, and you have no right to any further payment?" And is not the capitalist equally entitled to tell those of his workmen who expect and claim a share in his profit, that they have already received the value of their labour in wages, and have no right to expect more?

4. Does the price of food affect the rate of wages? Some people think so. Workmen often ask a rise of wages, because provisions are dear; and masters sometimes insist on a reduction of wages, because provisions are cheap; while some, who are neither masters nor workmen, say that the price of labour should be proportionate to the price of food. But all such persons only betray their ignorance of the fundamental laws of industrial economy. The price of food and the price of labour are determined by circumstances entirely different. Both, indeed, vary according to the law of demand and supply; but the fluctuations between demand and supply in the case of food are so much greater and more frequent than the like fluctuations in the case of labour, that the price of food is necessarily far more variable than the price of labour. Indeed, of all articles used by man, corn and the other fruits of the earth are the most variable in price;

and *that* for obvious reasons. Most other things can be produced in winter as well as in summer, and, indeed, at any time, if labourers and materials are forthcoming; but the fruits of the earth can be raised only at particular seasons. When the supplies of any other commodity are found to be insufficient, it is easy to make up the deficiency by an acceleration in the rate of production; but when the crops are deficient, we must wait for next harvest before any more can be raised. Besides, even when the supply of corn is ample, there is much greater difficulty in adjusting it to the wants of the people than in adjusting the supply of any other article. In a manufactory, there is little trouble in ascertaining how much raw material must be used in order to furnish a given amount of finished articles; and thus, when any particular quantity of the latter is required, it is known at once what supply of the former ought to be given out. But it is otherwise with the stock of grain that may remain in hand; for we cannot ascertain at seedtime the yield of the coming harvest. Nor should it be forgotten that the demand for food is of quite another and more urgent nature than the demand for most other articles. If clothing is dear, men may do well enough with old garments till the price falls; if houses have risen in rent, men may remove to a less expensive locality till rents come down. But food cannot be dispensed with till it become cheap; it must be had at whatever price. And thus a rise in the price of food does not check consumption to anything like the same extent as a rise in the price of other things. On the ground, then, of the specialties which distinguish both the supply of food and the demand for food from the supply and the demand in the case of other commodities, it is manifest that the price of food cannot determine or regulate the price of anything else.

5. A strong prejudice exists in many quarters against the use of machinery as a substitute for human labour. At one time, workpeople were so hostile to the introduction of cotton-spinning machines and other similar inventions, that they went about the country breaking them up; and, though violent measures are no longer resorted to, the introduction

of a new machine in any factory or workshop is still regarded by many operatives with jealousy and alarm, from the belief that it will throw them out of work.

Now, it is quite true that, when a machine is first brought into use, some workpeople suffer for a time by having their previous employment superseded. A power-loom, by doing the work of the hand-loom weaver, necessarily lessens the demand for hand-loom weavers; a reaping-machine, by doing the work of the reaper, necessarily lessens the demand for reapers. But it is only *for a time* that workpeople suffer in consequence of the use of machinery. Machinery does not lessen the work to be done by men—it only *changes* that work. Nay, it greatly increases the amount of work to be done; and if the hand-loom weaver, the reaper, or other operative is only wise enough to abandon the branch of work which the machine has superseded, and to betake himself to waiting on the machine or to some other branch of work which the machine has created, he will soon find that he is better off in respect both of employment and of wages than he was before.

A single power-loom does the work of many hand-loom weavers, and it does the work better and in shorter time. Its effect, therefore, is to lessen the cost of production, and so to cheapen the price of the article. The article being cheapened, the demand for it increases; and the increased demand necessarily causes more power-looms to be used, and thereby creates employment for a larger number of people than were employed before the introduction of the machine. Now, what is true of the power-loom in this respect, is equally true, in its degree, of every other mechanical substitute for human labour. Before the invention of the printing-press, books were copied by persons called *scribes*, who earned their living by copying. When the printing-press was introduced, these persons, of course, lost their employment. But before long there was more than sufficient employment for them at the printing-press, because of the cheapened cost and increased demand for books; and now there are a thousand times as many printers as there once were scribes. A century ago, a cotton-spinning machine was invented, which enabled one man to do the work of twenty, and, consequently, threw out of work for a time nineteen out of every twenty hand-spinners. But, erelong, the diminished price, caused by the productive power of the machine, so greatly increased the demand for cotton yarns, that there were many more persons wanted to attend to the new machines than were before employed in working the spinning wheels; and at this hour there are a hundred times as many cotton-spinners as there were a century ago.

It is an error, then, to suppose that operatives suffer eventual loss by the use of machinery. While machinery benefits *consumers*, by lowering the price of commodities, and *manufacturers*, by cheapening the cost of production, it also benefits workpeople, by providing in the end employment for a larger number of hands than before. They may suffer loss for a time; but they are sure, in the long run, to gain much more than they lose. And hence the course which a hand-worker should take, who finds himself thrown out of work by a new machine, is not to cry out against machinery, which is certain soon to become his friend, but to learn to work the machine as quickly as possible, or, if he cannot do that, to betake himself to some other branch of work. At such a time, as at all others, the most skilful and economical operative is the best off, for he has something to fall back upon when out of work, while he is also the best able to adapt himself to a new kind of work.

Compiled.

PROPHECY.

Man is endowed with faculties which enable him not only to recollect the past, but also, within certain limits, to anticipate the future; and his sagacity, guided by experience, aspires, in many instances, to the character of foresight. Many physical events—such as eclipses, the results of certain combinations of machinery, and the like—he can thus predict with infallible certainty; and even, in regard to the future effects of moral causes, he can frequently speak with perfect confidence.

But *Prophecy*, in the highest sense of the word, as relating to events beyond the range of human calculation, can belong only to prescience,—an attribute of that mind which is at once omniscient and omnipotent. To God only is the future as distinctly known as the past. He only can disclose the train of future events. And if any book, therefore, exists, which contains a series of such disclosures, such a book must necessarily have proceeded from His inspiration.

Such a book the Bible claims to be! Have we satisfactory evidence, then, that its predictions were promulgated before the events which they describe? Is there a palpable accordance between the predictions and the events? Are the events of such a nature, that, when the prophecies were promulgated, it was impossible for human sagacity to foresee their occurrence? If these three questions can be answered in the affirmative, we are furnished with an invincible argument for the inspiration and divine authority of the Bible.

There are in the Old Testament numerous prophecies of which the accomplishment is recorded in the New. Of this kind are those which relate to the Messiah. In the writings of David and Isaiah, we have a series of predictions, which foretell, in the most definite terms, the following circumstances:—That the Messiah was to be a descendant of David,—that he was to be the son of a virgin,—that he was to be born at Bethlehem,—that he was to reside for the most part in Galilee,—that he was to pass through a life of suffering,—that he was to be betrayed by a familiar friend,—that he was to be proceeded against as a culprit,—that he was to display consummate meekness and patience,—that he was to be cut off by a violent death, yet with the forms of justice,—that his apparel was to be parcelled out among his executioners,—that, although classed among malefactors, he was to be interred in a rich man's tomb,—that he was to rise again from the dead without undergoing the process of corruption,—and that he was to leave this world and ascend up into heaven.——Now, apply to these predictions the three tests which have been mentioned. Were these predictions written and published previously to the events? Let the Jews, the adversaries of Christianity, answer! These predictions are in their Bibles as well as in ours; and it is a well-authenticated fact, that they were extant, not only in the original Hebrew, but also in a Greek translation, long before the era of the Gospel history.—Is there an obvious and palpable accordance between these predictions and the record of the occurrences? Compare the passages in the Psalms and in Isaiah with the history of the events as given by the evangelists, and you will at once perceive the precise, the minute, and the multiplied coincidences between the one and the other.—Nor is the third criterion less fully satisfied. Is it at all probable that circumstances so complicated, so unparalleled, so far removed from the range of human conjecture, could have been foreseen even by the most sagacious of our race? It is not. Such predictions cannot be accounted for in any other way than by tracing them to Divine prescience: nor can the books which contain them be ascribed to any but inspired Authorship.

There are many prophecies both in the Old and in the New Testament, of which the accomplishment is recorded in profane history. Such, for example, are Daniel's astonishing predictions respecting the four successive monarchies, which, for a course of ages, were to give laws to the most civilized nations of the earth. Such also are the explicit predictions respecting Egypt, and Tyre, and Nineveh, and Babylon, and Ishmael; and the prophecies in regard to the destruction of Jerusalem, and the final dispersion of the Jews;—all of which have been so signally fulfilled. All these, it must be evident, answer the tests already mentioned.

A third class of Scripture-prophecies relate to events which are still in the course of fulfilment. They regard principally the progressive diffusion of Christianity through the Gentile world, and are to be found in almost every book of the Bible from Genesis to Revelation. To such predictions the second test is only partially applicable, but the first and third apply and answer in all their latitude. Nothing short of Divine prescience could have foretold even such a propagation of Christianity as that which has already taken place.

Think of the state of the world—we say not in the days of Abraham, when the prediction was first made, or of David, or of Isaiah, who successively repeated it, but even in the days of the Apostles—think of the humble rank of the first propagators of the Gospel, and of the opposition with which they had to contend both from Jews and from Gentiles,—and then say if it be at all supposable that human expectation could have surmised, or human sagacity foreseen, the triumphs of Christianity?

There is a fourth class of prophecies,—those which are still unfulfilled. Such prophecies, of course, cannot *at present* be adduced as evidence of the divine authority of the Bible. In the course of ages, however, they will, doubtless, be available for this purpose; and, in the meantime, they ought to command our implicit belief, as forming a part of that record which is proved, by the *fulfilled* predictions which it contains, to be a revelation from Heaven. BURDER.

THE DAY OF JUDGMENT.

THE Lord shall come! the earth shall quake;
The mountains to their centre shake;
And, withering from the vault of night,
The stars shall pale their feeble light.
The Lord shall come! but not the same
As once in lowliness he came,—
A silent Lamb before his foes,
A weary man, and full of woes.
The Lord shall come! a dreadful form,
With rainbow-wreath, and robes of storm,
On cherub-wings, and wings of wind,
Appointed Judge of all mankind!
Can this be he who wont to stray
A pilgrim on the world's highway,
Oppressed by power, and mocked by pride,
The Nazarene,—the Crucified?
While sinners in despair shall call,
"Rocks, hide us; mountains, on us fall!"
The saints, ascending from the tomb,
Shall joyful sing, "The Lord is come!" HEBER.

I GAZE aloof on the tissued roof,
Where time and space are the warp and woof,
Which the King of Kings as a curtain flings
O'er the dreadfulness of eternal things.

But soon the whole, like a parched scroll,
Shall before my amazed sight uproll;
And without a screen, at one burst be seen
The Presence wherein I have ever been.

Oh! who shall bear the blinding glare
Of the Majesty that shall meet us there?
What eye may gaze on the unveiled blaze
Of the light-girdled throne of the Ancient of Days?
Lord Christ, us aid! Lord Christ! be our shade,
That in that dread day we be not dismayed.

WHITEHEAD.

STAND the Omnipotent decree,
Jehovah's will be done!
Nature's end we wait to see,
And hear her final groan!
Let this earth dissolve and blend
In death the wicked and the just:
Let those ponderous orbs descend,
And grind us into dust!

Rests secure the righteous man,
At his Redeemer's beck,
Sure to emerge and rise again,
And mount above the wreck:
Lo! the heavenly spirit towers,
Like flames o'er Nature's funeral pyre;
Triumphs in immortal powers,
And claps his wings of fire!

C. WESLEY.

SELF-HARMONY OF THE HOLY SCRIPTURES.

THE structure and contents of the Bible would seem, at first sight, to forbid the possibility of its being a self-harmonious composition. The Bible is not one book, but a collection of sixty-six different books. It is the production, not of one writer, but of thirty-six different writers—men of every diversity of rank, talent, and mental culture. It is a work, moreover, not of one age, but of many and distant ages; for the opening books date six hundred years earlier than any other literary composition extant, while the closing book is a production of the age of the Caesars—a period fifteen centuries later. And then how various are the books in kind—some being histories; some, biographies; some, poems; some, digests of public law; some, collections of proverbs; some, epistles to churches; some, private letters to friends! Certainly, it could never have been expected beforehand that a series of works, open to so many sources of diversity, should exhibit anything at all approaching a systematic unity of thought and design.

Nevertheless, the perfect doctrinal agreement of the sacred books is one of their most indisputable properties. The Scripture-authors are not only entirely at one on all the subjects which they touch, but undesignedly contribute, each his contingent, towards the completion of a magnificent UNITY. Their several portions are all found, when combined, to fit and dovetail one into another, and together form a SYSTEM of doctrine and duty so harmonious and perfect that no part can be withdrawn without creating a defect, and none added without causing a redundancy! Do we draw an unwarranted inference, when we conclude, that these men must have been under the guidance of that Omniscient Mind which, "under diversities of operations, worketh as the self-same Spirit, dividing to every man severally as he will?"

Nor is this harmony of the Bible with itself observable only in the systematic completeness and consistency of its doctrines. It is equally apparent in the wonderful correspondence which exists between the typical institutions described in the Old Testament and the events recorded in the New. The various observances of the Mosaic economy—its lustrations and sacrifices, and sacred festivals—are found, on examination, to be just so many scenical representations of the facts and blessings described, in literal terms, in the writings of the evangelists and apostles. These complicated rites appear, when we go no farther than the Old Testament, to be nothing more or better than a round of burdensome formalities. But when we pass on to the Gospels and Epistles, we discover them to be "patterns of good things to come"—foreshadows of real substances. The moment that the person, life, and offices of Christ are presented by their side, the key of interpretation seems to be applied to a scroll of hieroglyphics. The dumb elements become vocal when acted on by the light of the Gospel—like the mute chords in the ancient statue of Memnon when struck by the beams of the morning sun. Can such a singular agreement be the result of chance? If there were only here and there a resemblance between "the shadows" of the Mosaic economy and the substance of the Gospel, there might be plausibility in the idea that the likeness was accidental. But when the likeness can be traced to the minutest particulars—and the difficulty is, not to find the reciprocity, but to detect the disagreement—are we not forced to admit *designed* similitude, and to look to a higher region than this earth for the Designer?

And there is a third point of concord, still less to be expected, which characterizes these books—their reciprocal relation as successive links in the chain of a gradually expanding revelation. The Scriptures open up their prominent themes—the character of God, the redemption by Christ, the prospects of man—slowly and progressively. These grand themes employ the pens of all the sacred writers; but, in developing them, the second writer makes an advance upon the first, the third upon the second, the fourth upon the third; and it is not till you reach the latest, that you find yourself amidst the full splendour of a light which has been brightening as you advanced. Nor is the method of development the same with that pursued in other writings. In other literary works, the subject is opened up by simply adding idea to idea. But in the Scriptures the subject advances—not by addition, but by *expansion*. The whole outline is given from the *first*, and what we find, as we proceed, is not a new or different delineation, but merely a *gradual filling* up of the picture. For example, in the very first chapter of Genesis, the words, "Let *us* make man in *our* image," contain, as in its germ, the doctrine of a trinity of persons in the Godhead;—in like manner, in the third chapter, the whole scheme of redemption by a woman-born Saviour is wrapped up, as the oak in the acorn, in the prophecy, "The seed of the woman shall bruise the head of the serpent;"—while, no farther on than the fifth chapter, this brief account of Enoch—"Enoch walked with God, and he was not, for God took him,"—presents us with an outline of almost all that the Scriptures reveal concerning the spiritual experience and eternal destiny of the godly. The subsequent books revert to these subjects only to develop them more fully. The views given of the Divine character and of the way of salvation are identical from Genesis to the Apocalypse; and the sole difference is, that the subject enlarges as the revelation proceeds—each fresh exhibition being an expanded picture of what preceded, and a mute prophecy of what is to follow.

Such a method of progressive evolution has no parallel in human compositions,—nay, no parallel in human handiworks of whatever sort. Its only parallel is to be found in the works of Nature. How do plants attain their size? Is it not by an *expansion* of the parts, rather than by an addition to them? How do animals increase in bulk? In a way precisely similar. Every animal is the same and complete in all its parts from the first—the majestic oak is but the acorn expanded—the lion is but a development of what existed in the lionet. Can any two things be liker each other than the methods of progressive development thus pursued in the Scriptures and in the natural world? Is such a marked resemblance accidental? Is it not rather a presumption that Nature and Scripture are but different productions of one and the same forecasting Mind?

RHETORICAL EXTRACTS.

Against the employment of Indians in the American War. —WHO is the man that, in addition to the disgrace and mischiefs of the war, has dared to authorize and associate to our arms the tomahawk and the scalping-knife of the savage—to delegate to the merciless Indian the defence of disputed rights, and to wage the horrors of his barbarous war against our brethren? My Lords, these enormities cry aloud for redress and punishment. But, my Lords, this barbarous measure has been defended, not only on the principles of policy and necessity, but also on those of morality; "for it is perfectly allowable," says Lord Suffolk, "to use all the means that God and nature have put into our hands." I am astonished, I am shocked, to hear such principles confessed—to hear them avowed in this House, or in this country. "That God and nature have put into our hands!" What! to attribute the sacred sanction of God and nature to the massacres of the Indian scalping-knife! to the cannibal savage, torturing, murdering, devouring, drinking the blood of his mangled victims! Such notions shock every precept of morality, every feeling of humanity, every sentiment of honour. These abominable principles, and this more abominable avowal of them, demand the most decisive indignation. I call upon that right reverend, and this most learned bench, to vindicate the religion of their God, to support the justice of their country. I call upon the Bishops to interpose the unsullied sanctity of their lawn—upon the Judges to interpose the purity of their ermine—to save us from this pollution. I call upon the honour of your lordships to reverence the dignity of your ancestors, and to maintain your own. I call upon the spirit and humanity of my country to vindicate the national character. I invoke the genius of the Constitution! My Lords, I am old and weak, and at present unable to say more; but my feelings and indignation were too strong to have said less. I could not have slept this night in my bed, nor even have reposed my head upon my pillow, without giving vent to my eternal abhorrence of such principles.

LORD CHATHAM.

British Freedom.—Liberty is commensurate with and *inseparable* from British soil. British law proclaims even *to the stranger* and the sojourner, the moment he sets his foot upon British earth, that the ground on which he treads is holy, and consecrated by the genius of Universal Emancipation! No matter in what language his doom may have been pronounced—no matter what complexion incompatible with freedom an Indian or an African sun may have burnt upon him—no matter in what disastrous battle his liberty may have been cloven down—no matter with what solemnities he may have been devoted upon the altar of slavery—the first moment he touches the sacred soil of Britain, the altar and the god sink together in the dust; his soul walks abroad in her own majesty; his body swells beyond the measure of his chains, that burst from around him; and he stands redeemed, regenerated, and disenthralled, by the irresistible genius of Universal Emancipation! CURRAN.

Marie Antoinette.—It is now sixteen or seventeen years since I saw the Queen of France, then the Dauphiness, at Versailles; and surely never lighted on this orb, which she hardly seemed to touch, a more delightful vision. I saw her just above the horizon, decorating and cheering the elevated sphere she had just begun to move in,—glittering like the morning star, full of life, and splendour, and joy. Oh! what a revolution! and what a heart must I have to contemplate, without emotion, that elevation and that fall! Little did I dream, when she added titles of veneration to those of enthusiastic, distant, respectful love, that she should ever be obliged to carry the sharp antidote against disgrace, concealed in that bosom; little did I dream that I should have lived to see such disasters fallen upon her in a nation of gallant men,—in a nation of men of honour and cavaliers. I thought ten thousand swords must have leaped from their scabbards to avenge even a look that threatened her with insult. But the age of chivalry is gone; that of sophisters, economists, and calculators, has succeeded; and the glory of Europe is extinguished for ever. Never, never more, shall we behold that generous loyalty to rank and sex, that proud submission, that dignified obedience, that subordination of the heart, which kept alive, even in servitude itself, the spirit of an exalted freedom. The unbought grace of life, the cheap defence of nations, the nurse of manly sentiment and heroic enterprise, is gone! It is gone, that sensibility of principle, that chastity of honour, which felt a stain like a wound, which inspired courage whilst it mitigated ferocity, which ennobled whatever it touched, and under which vice itself lost half its evil, by losing all its grossness. **Burke.**

Law Reform.—The course is clear before us; the race is glorious to run. You have the power of sending your name down through all times, illustrated by deeds of higher fame, and more useful import, than ever were done within these walls. You saw the greatest warrior of the age—conqueror of Italy, humbler of Germany, terror of the North—saw him account all his matchless victories poor compared with the triumph you are now in a condition to win—saw him contemn the fickleness of Fortune, while, in despite of her, he could pronounce his memorable boast, "I shall go down to posterity with the Code in my hand!" You have vanquished him in the field, strive now to rival him in the sacred arts of peace! Outstrip him as a lawgiver, whom in arms you overcame! The lustre of the Regency will be eclipsed by the more solid and enduring splendour of the Reign. The praise which false courtiers feigned for our Edwards and Harrys, the Justinians of their day, will be the just tribute of the wise and the good to that monarch under whose sway so mighty an undertaking shall be accomplished. Of a truth, the holders of sceptres are most chiefly to be envied, for that they bestow the power of thus conquering, and ruling thus. It was the boast of Augustus, that he found Rome of brick, and left it of marble,—a praise not unworthy of a great prince, and to which the present reign also has its claims. But how much nobler will be the Sovereign's boast, when he shall have it to say, that he found law dear, and left it cheap; found it a sealed book, left it a living letter; found it the patrimony of the rich, left it the inheritance of the poor; found it the two-edged sword of craft and oppression, left it the staff of honesty and the shield of innocence! **Brougham.**

Death of Nelson.—The death of Nelson was felt in England as something more than a public calamity; men started at the intelligence, and turned pale, as if they had heard of the loss of a dear friend. An object of our admiration and affection, of our pride and of our hopes, was suddenly taken from us; and it seemed as if we had never till then known how deeply we loved and reverenced him. What the country had lost in its great naval hero—the greatest of our own and of all former times—was scarcely taken into the account of grief. So perfectly, indeed, had he performed his part, that the maritime war, after the battle of Trafalgar, was considered at an end. The fleets of the enemy were not merely defeated, but destroyed; new navies must be built, and a new race of seamen reared for them, before the possibility of their invading our shores could again be contemplated. It was not, therefore, from any selfish reflection upon the magnitude of our loss that we mourned for him: the general sorrow was of a higher character. The people of England grieved that funeral ceremonies, and public monuments, and posthumous rewards, were all which they could now bestow upon him whom the king, the legislature, and the nation would have alike delighted to honour; whom every tongue would have blessed; whose presence, in every village through which he might have passed, would have wakened the church-bells, have given schoolboys a holiday, have drawn children from their sports to gaze upon him, and old men from the chimney-corner to look upon Nelson ere they died. . . . There was reason to suppose, from the appearances upon opening his body, that, in the course of nature, he might have attained, like his father, to a good old age. Yet he cannot be said to have fallen prematurely, whose work was done; nor ought he to be lamented, who died so full of honours, and at the height of human fame. The most triumphant death is that of the martyr; the most awful, that of the martyred patriot; the most splendid, that of the hero in the hour of victory;—and if the chariot and the horses of fire had been vouchsafed for Nelson's translation, he could scarcely have departed in a brighter blaze of glory. He has left us, not indeed his mantle of inspiration, but a name and an example which are at this hour inspiring thousands of the youth of England—a name which is our pride, and an example which will continue to be our shield and our strength. SOUTHEY.

Regret for the Dead.—Ay! go to the grave of buried love, and there meditate! there settle the account with thy conscience for every past endearment unregarded of that departed being who can never, never, never return to be soothed by thy contrition! If thou art a child, and hast ever added a sorrow to the soul, or a furrow to the silvered brow, of an affectionate parent; if thou art a husband, and hast ever caused the fond bosom that ventured its happiness in thy arms, to doubt one moment of thy kindness or thy truth; if thou art a friend, and hast ever wronged, in thought, word, or deed, the spirit that generously confided in thee; if thou art a lover, and hast ever given one unmerited pang to that true heart which now lies cold and still beneath thy feet;—then be sure that every unkind look, every ungracious word, every ungentle action, will come thronging back upon thy memory, and knocking dolefully at thy soul; then be sure that thou wilt lie down sorrowing and repentant on the grave, and utter the unheard groan, and pour the unavailing tear,—more deep, more bitter, because unheard and unavailing. . . . Then weave thy chaplet of flowers, and strew the beauties of nature about the grave; console thy broken spirit, if thou canst, with these tender yet futile tributes of regret: but take warning by the bitterness of this thy contrite affliction over the dead, and henceforth be more faithful and affectionate in the discharge of thy duties to the living.

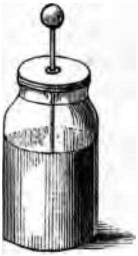
WASHINGTON IRVING.

THUNDER-STORMS.

WHO has not watched the approach of a thunder-storm? Far away in the sky a dense black cloud appears, small in bulk when it first lifts its head above the horizon, but rapidly expanding, as it seems to climb the heavens. The lower surface is dark in hue, but level in outline; whilst the upper assumes the aspect of dome-shaped mountains whitened with snow. This is the giant of the storm. His advent seems to be the signal for the appearance of numerous jagged cloudlets, which come trooping from their hiding-places, and move to and fro in confusion, as if angry at the presence of the phantom, yet constrained to answer the summons. These vapoury myrmidons generally recede from each other, as if repelled; but, at length, yielding to the attraction of the master mass, they hasten towards it, and are soon absorbed in its huge bulk. When the giant has thus mustered his forces, and spread his vast form over many a rood of sky, he prepares to launch his darts, by flinging out long ragged limbs of vapour towards the ground. Meanwhile, the atmosphere is sultry and stagnant. The head aches, and the frame is enfeebled by a nameless languor. The very brutes become living electrometers. Gloomier and gloomier grows the scene. At length the big drops begin to descend. The wind comes and goes in feverish gusts, or fetches huge melancholy sighs. Suddenly the cloud is rifted, and a red bolt is hurled from the giant's arm, shattering some tall spire, splintering some stubborn tree, or reducing some proud man to a cindery corpse. Then the lips of the phantom part in thunder, and the firmament rings with the wild laughter of the spirit of the tempest, as if in mockery of the mischief he has done.

In order, then, to a thunder-storm, the first requisite is a mass of vapour in a state of electrical excitement; nor is it necessary that there should be two such masses or clouds, though, in many instances, there are two. An electrical tourney does, indeed, require two combatants; but the battle may be not between a cloud and a cloud, but between a cloud and the earth; and, in point of fact, the discharge is very frequently between the heavens and the earth.

A storm-cloud being formed in the atmosphere, let us see what will be its action on the earth. In the Leyden phial, the internal coating of tinfoil, when charged with positive electricity, operates through the glass inductively, and attracts an equal quantity of negative electricity to the external lining of the jar. But as glass is a non-conductor, the two fluids, however anxious to amalgamate, can take no steps to that end, unless they can succeed in rupturing the vitreous barrier which lies between them. Should they, however, succeed in this, a vivid spark is seen, a sudden clap of artificial thunder is heard, and the electric equilibrium is straightway restored. Now, in the same manner, a cloud, charged with positive electricity, will produce by induction, while hovering over the earth, an opposite accumulation of negative electricity in the ground beneath. The interposed stratum of air between the cloud and the under-lying earth, being a non-conductor, will, for a time, like the glass of the Leyden phial, obstruct the amalgamation of the two fluids. But when these fluids have acquired sufficient intensity, or are brought into sufficient proximity, the aerial barrier will give way, a disruptive discharge will take place, and the electric equilibrium will be forthwith established amidst a blaze of light and a hideous crash of thunder. It is obvious that the same results may arise in the case of two clouds. For these, floating at different altitudes, and forming, with the interposed layer of air, an apparatus similar to the coatings and glass of the Leyden phial, will constitute an electric arrangement capable of producing a storm.



Leyden Jar:—A thin glass jar coated on both sides, up to a certain height, with tin-foil. The wire, terminating in a metallic knob, communicates with the internal coating. The jar is charged by holding the knob near the conductor of an Electrical Machine: it is discharged by bringing the knob and the external coating into communication, by means of a flexible metal rod.

There are three classes of lightning—viz., 1. *Forked* lightning, where the discharge appears like a long luminous line, bent into angles and zigzags, and varying in colour from white to blue, purple, or red. It is called forked, because it occasionally divides into two or more branches before reaching the earth, and thus simultaneously strikes two or more objects. 2. *Sheet* lightning, which, instead of flashing to long distances, like the former, simply gilds the margin of the cloud from which it leaps, or else suffuses its surface with a lurid radiance; and 3. *Balls of fire*, which do not, like the other lightnings, flame out for a moment and then vanish, but remain visible for a considerable time, and pursue a somewhat irregular course. This third class differs so widely from the others, that doubts have been entertained of its belonging at all to the fraternity of lightnings. An ordinary flash darts from horizon to horizon in the thousandth part of a second; yet these globular lumps of fire traverse the air at such a leisurely pace that even the foot can sometimes outstrip them. While a terrible storm was raging at Milan, M. Butti had his attention withdrawn from the commotion in the heavens by a little human hubbub in the street. *Guarda! guarda!* cried a number of voices. On reaching the spot, he perceived a globe of fire moving along the middle of the street at some distance from the ground, but with an upward slant in its course. Eight or ten persons were in chase of the meteor, and by advancing at a quick step were enabled to keep up with its motion. M. Butti, anxious to know a little more of the strange traveller, ran on, and joined in the hue and cry. On it went for about three minutes more, still sauntering along at the same cool pace; but, at last, it came in contact with the tower of a church, and vanished with a moderate detonation.

The power of forked lightning is tremendous; and its effects are, in many instances, not a little singular. When the fluid happens to meet with some obstruction in its course, it frequently shatters the non-conducting object; and often it exerts, not only a linear force, like a cannon-ball, but also a radiating force, like a bombshell, bursting substances asunder as if they had been charged with gunpowder. Some bolts will dash through resisting objects by tearing great openings, as was the case in a Cornish church, where apertures were made in the solid wall of the belfry, one of which was fourteen inches square and six inches deep. In other instances, lightning drills small holes, which are not less surprising for their perfect circularity of form. Some years ago, when a gentleman at Poole was writing before a desk during a thunderstorm, the lightning cut out from one of the windowpanes a perfectly circular disc of glass, which fell upon the paper on which he was writing.

If the apertures just named may be said to indicate the *breadth* of the lightning when it strikes, there are occasions when it stamps its form on the soil, so as to leave *longitudinal* evidence of its transit. Fulgurites are tubes which the lightning constructs, when it falls upon a siliceous spot, by fusing the sand. They may be called casts of thunderbolts. They consist of hollow tubes, with a diameter varying from one-fiftieth of an inch to upwards of two inches, and frequently tapering as they descend until their extremities are reduced to a mere point. At the surface of the ground there may be a single tube only; but, at some little depth, this will perhaps separate into two or three branches; and these, again, sometimes throw off twigs a few inches in length, so that, taken as a whole, the lightning-sheath appears something like the skeleton of an inverted tree. The entire extent of the tubes often amounts to as much as thirty feet. Internally, they are lined with glass, as smooth and perfect as if it had been manufactured in a glass-house. Outwardly, they are composed of grains of quartz or sand, exhibiting decided traces of fusion, and glued together so as to form a rind or crust, which has been compared to the bark on the stump of an old birch-tree.

The power of fusing substances is a prominent property of lightning. The surfaces of rocks have been vitrified by this terrible meteor. Metals have been reduced to fluids when they interrupted its furious march. An American packet, the *New York*, was attacked by a storm on her passage to England, in April 1827; several links of an iron chain were melted, and, descending in glowing drops upon the deck, set fire to everything they touched; part of the chain is even said to have burnt like a taper. Connected with this power of fusion, there is one circumstance which is very remarkable. It would seem that lightning can develop sufficient heat to liquefy metallic bodies, without damaging or even singeing the more fragile materials with which they happen to be associated. Aristotle says that copper has been melted off a shield without the wood being injured;

and Seneca affirms that money has been fused in a purse without the latter being burnt.

The preceding are examples of the mechanical effects of lightning. It works chemically as well. It has the power of developing a peculiar odour, somewhat like the fumes of burning sulphur. Wafer mentions a storm on the Isthmus of Darien, which diffused such a sulphureous stench throughout the atmosphere, that he and his companions could scarcely draw their breath, particularly when the party plunged into the woods. Nitric acid, too, is formed in the atmosphere by lightning. Liebig, having collected seventy-seven samples of rain water, found that seventeen which had fallen during thunder-storms contained nitric acid in greater or smaller quantities, while the remaining sixty, drawn from the clouds in times of peace, exhibited no traces of this virulent liquid. Arago suggests that further investigations on this point may lead to some inferences respecting the supply of those natural deposits of nitre, the existence of which, in certain localities where no animal matter is to be found, is so difficult to explain. "There would be something particularly curious," he adds, "in showing that thunderbolts prepare, in the upper regions of the atmosphere, the principal element of that other thunderbolt of which men make such prodigious use for mutual destruction."

Lightning can also produce magnetic effects, as common electricity is well known to do. A shoemaker in Swabia had his tools thus magnetized, to his indescribable annoyance. He had to be constantly freeing his hammer, pincers, and knife, from the nails, needles, and awls, which were getting caught by them as they lay together on the bench. The poor fellow, who was of course no philosopher, was compelled to relinquish the use of his bewitched implements. If lightning gets into a clock or chronometer, it will so magnetize the works as to vitiate their operations completely. Still more dangerous is the power which it possesses of altering, or even destroying magnetism where it already exists. Nearly two centuries ago, a couple of English ships were sailing from London to Barbadoes. On the voyage, a flash of lightning fell upon one of the vessels, but inflicted no damage on the other. Suddenly the captain of the suffering ship was observed to alter his course, and turn his prow, as if making for England again. His consort inquired the reason, and found that the whole crew believed they were still proceeding to Barbadoes. A careful inspection of the compasses proved that the poles had been completely reversed by the lightning. Had this event happened to a solitary ship, what would the captain have thought when the shores of the Old World rose up before him, while engaged in a fruitless hunt for those of the New!

Many other effects have been attributed to electrical commotions, for which it would be hazardous to vouch; and divers small charges also are often brought against the thundering Jove. Says the dairyman, "You have curdled my milk!" "And soured my beer!" continues the brewer. "And tainted my fresh meat!" cries the irritated butcher. For these accusations, however—whimsical as they seem—it would be difficult to say that there is no foundation, when we remember that nitric acid is formed during thunder, and that the electric fluid develops a peculiar effluvium.

The mischievous propensities of lightning have compelled men to inquire whether something may not be done to avert or disarm this devastating meteor. And happily, after many abortive plans and projects, science has at length taught us how Jove's darts may be blunted. The principle adopted is not that of repelling the enemy; for if the lightning is prepared to strike, it is idle to think of arresting the stroke. It is found to be the safest policy to treat with the enemy, and to receive his advances courteously. Let him be provided with an easy route, and he may be prevailed upon to make a mild journey from the skies, instead of darting explosively to the earth. A plain copper rod, with its top peering above the roof of a house, and its other extremity sunk in the ground, may seem to be a contrivance little fitted to persuade the lightning to leave the house untouched, and to walk off by the rod into the earth. But the philosophy embodied in this simple apparatus is the result of many years of research; and experience proves that the research has not been expended in vain. What is wanted is a conductor, in traversing which the lightning will meet with the least resistance. And as copper is found to be of all substances the best transmitter of electricity, so—in order to drain off the dangerous fluid from the cloud to the earth, and to prevent it from making your house, or ship, or steeple, its pathway—you have only to provide a copper rod, considerably elevated above the object to be protected, of sufficient diameter to carry a good cargo of lightning without melting under its fiery load, continuous in its structure from end to end, and pointed at its upper extremity. All honour to an invention which can shield the gallant ship at sea and the stately building on shore with equal effect from the deadly bolt—which can guide the hissing shaft from the sky, and bury it deep in the soil, a powerless and extinguished thing—and which, plucking the fiery sting from the spirit of the storm, can leave him to pursue his course, muttering a few empty menaces, or dissipating his wrath in harmless fulminations!

Abridged from the BRITISH QUARTERLY REVIEW.

SHIPWRECK IN A CALM.

THE Moon is sunk, and a clouded gray
  Declares that her course is run;
And like a god who brings the day,
  Up mounts the glorious Sun.
Soon as the light has warmed the seas,
From the parting cloud fresh blows the breeze;
And that is the spirit whose well-known song
Makes the Vessel to sail in joy along.
No fears hath she;—her giant-form,
O'er wrathful surge, through blackening storm,
Majestically calm would go,
'Mid the deep darkness white as snow!
But gently now the small waves glide,
Like playful lambs o'er a mountain's side.
So stately her bearing, so proud her array,
The Main she will traverse for ever and aye.
Many ports will exult at the gleam of her mast—
Hush! hush! thou vain dreamer! this hour is her last.

Five hundred souls in one instant of dread
  Are hurried o'er the deck;
And fast the miserable Ship
  Becomes a lifeless wreck.
Her keel hath struck on a hidden rock,
  Her planks are torn asunder,
And down come her masts with a reeling shock,
  And a hideous crash like thunder.
Her sails are draggled in the brine,
  That gladdened late the skies,
And her pendant that kissed the fair moonshine
  Down many a fathom lies.

Oh! many a dream was in the Ship,
  An hour before her death;
And sights of home with sighs disturbed
  The sleeper's long-drawn breath.
Instead of the murmur of the sea,
The sailor heard the humming tree
  Alive through all its leaves,
The hum of the spreading sycamore
That grows before his cottage-door,
  And the swallow's song in the eaves;
His arms enclosed a blooming boy,
Who listened with tears of sorrow and joy
  To the dangers his father had passed;
And his wife—by turns she wept and smiled.
As she looked on the father of her child
  Returned to her at last:
—He wakes at the Vessel's sudden roll,
And the rush of waters is in his soul;
Astounded the reeling deck he paces,
'Mid hurrying forms and ghastly faces—
  The whole Ship's crew are there!
Wailings around and overhead,
Brave spirits stupified or dead,
  And madness and despair.

  Now is the Ocean's bosom bare,
Unbroken as the floating air;
The Ship hath melted quite away,
Like a struggling dream at break of day.
No image meets my wandering eye
But the new-risen sun, and the sunny sky.

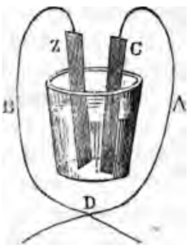
Though the night-shades are gone, yet a vapour dull
Bedims the waves so beautiful;
While a low and melancholy moan
Mourns for the glory that hath flown.

WILSON.

THE ELECTRIC TELEGRAPH.

As the etymology of the word implies (Gr. *tele*, distant, and *grapho*, I write), a telegraphic instrument is used for the conveyance of messages or signals to a distance. Various methods are employed for this purpose, but none has been so widely applied, or has proved so beneficial in its use, as the electric telegraph. This method of telegraphing is accomplished by setting up a current of electricity between the places from and to which messages are intended to be sent, and employing it in the production of visible or audible signals representing letters and words. The apparatus employed consists essentially of three distinct portions,—viz., the *voltaic battery*, by which electricity is generated; the *wires*, by means of which the electric force is transmitted; and the *instruments*, which regulate its transmission for the conveyance of messages.

If a plate of zinc and a plate of copper be placed side by side, but without touching, in a vessel containing water to which a small proportion of sulphuric acid has been added, no electric action will be manifested. If, however, the plates be made to touch at a point outside the liquid, or if, as in the annexed figure, a metal wire be attached to each, and the two wires be brought into contact, an electric current is immediately set in action. The direction of this current is always from the zinc plate Z through the liquid, to the copper plate C, and thence along the wires A B, by their junction at D, to the zinc plate again. This the simplest form of a voltaic cell produces only a feeble current. Those generally used for telegraphic purposes, though the same in principle, differ from it more



or less in construction; and in order to produce a current of sufficient intensity, a number of these cells are united together. That is done by connecting, by means of a wire or band of copper, the copper plate of each cell with the zinc plate of the cell immediately following it in the direction of the current. The arrangement here described is called a *battery*, and to the terminal plates—the zinc plate called the negative pole, and the copper plate the positive pole—are attached the wires which, when united, complete the circuit. Along these wires flows a current of electricity, the combined force of all the cells, strong in proportion to the number of them employed.

In order to maintain electric communication between two places, it is necessary that they be first connected by a continuous line of wire along which the electric current may flow. For this purpose an iron wire, coated with zinc to prevent rusting, is generally stretched the whole way between the two places. The wires are supported on tall posts placed 60 to 150 yards apart, and usually furnished with cross-bars near the top, on which the wires may rest. In order to prevent the electricity being carried of from the line-wire, porcelain insulators, in the form of small tubes or of inverted cups, are attached to the posts or cross-bars, and these prevent the woodwork coming in contact with the wire and thereby dissipating the electricity. In other cases copper wires are used, surrounded by a coating of gutta-percha and enclosed in metal pipes, which are sunk beneath the surface of the ground. Where a channel or arm of the sea or an ocean has to be crossed, a submarine cable is employed. This is constructed of copper wires enclosed in gutta-percha and tarred yarn, the whole being protected from injury by a close-fitting coat-of-mail composed of iron wires twisted spirally around it.

We will now suppose that two stations—at London and Edinburgh, for example—have been connected by a line of wire stretched between them; and that for the purpose of sending messages from London a battery has been placed in the station there. To the terminal copper plate of this battery the line wire is attached. The Edinburgh station is also provided with a battery, which is only called into use when Edinburgh is the sending and London the receiving station. Something more, however, is required before an electric current can be supposed to have been established. A path must be provided for its return to the zinc plate commencing the series in the London battery. In the case of the single cell from which we got our first idea of the electric current and the means of setting it in motion, it was seen that it was not until the free ends of the wires were brought together that electricity was generated. Suppose, however, that instead of being made to touch each other, the ends of the wires had been brought into contact with some intervening substance capable of conducting electricity—had, for example, been dipped in a vessel containing a liquid similar to that in which the plates attached to their other extremities were immersed. In such a case the circuit would have been completed, just as if the wires had themselves been united, and the current would have continued to traverse it. A knowledge of the fact here illustrated enables us to understand how it is, that while it is necessary for the transmission of the electric force that one continuous line of wire should join the two stations, it is not at all requisite, as would at first sight appear to be the case, that a *second wire* should be provided for its return. The earth itself has been found capable of being utilized for the completion of an electric circuit between any two places on its surface, however wide apart, just as the liquid into which the two wires were dipped completed the circuit in the case of the single cell. In order, then, to provide a path for the return of the electric current from Edinburgh to London it is only necessary to connect each end of the line with the earth. This is accomplished by sinking deep into the ground at each station a large plate of copper to which is attached a wire from the pole of the battery opposite to that connected with the line-wire, and providing a means by which the battery at the receiving station is put out of the circuit and the line-wire conducted direct to earth. A continuous current then flows from the first zinc plate of the London battery to the terminal copper plate; thence by the line-wire (passing by the battery) to the earth-plate at Edinburgh, and back by the ground to the earth-plate at London, and so to the first zinc plate again. Electric connexion thus established is, however, useless till by its means intelligible messages can be transmitted.

This brings us to a consideration of the *instruments* by means of which messages are sent from one end of the line and recorded at the other. To the famous Dutch philosopher Oersted is due the discovery that an electric current, if made to pass near to and parallel with a compass-needle poised on a pivot, will cause the needle to be deflected to one side or the other of its natural position. The needle telegraph instrument owes its origin to this discovery; and in it the force of the electric current, as applied towards deflecting the needle, is intensified by coiling the wire many times around a wooden frame in which the needle is enclosed. The needle, thus surrounded, is placed vertically on the instrument, behind a dial-plate; a similar needle, moving in unison with it, being visible to the operator in front. By means of a handle connected with a series of wires and springs, the operator, reversing the current at will, causes the needle to be deflected to the right hand or to the left. A code of signals having been agreed upon, the words of any given message, spelled out letter by letter by the operator upon the instrument at the sending station, are indicated by the motions of the needle on the dial-plate of the instrument at the other end of the line, and read off by the operator there. The entire alphabet is represented by the movements of the needle to right or left, the letter A being signalled by a deflection to the left followed by one to the right, B by one to the right followed by three to the left, and so on. The same instrument is employed both in sending and receiving messages.

The needle instrument furnishes no record of the message sent by it other than that written off by the receiving agent, the correctness of which must depend on the care and attention exercised by him. Another description of instrument is in very general use, however, which itself records the message as it receives it from the line-wire. The mode of telegraphing in which it is used is called, from the name of its inventor, the Morse system. In it two kinds of instruments are requisite—one for transmitting, the other, of different construction, for recording the messages. The former consists of a lever moving on an axis, and provided at the upper surface of its longest extremity with a vulcanite knob or handle by means of which it is depressed by the operator as occasion requires; and on its under surface are two knobs of platinum, placed immediately over other knobs communicating by wires with the battery and the recording instrument. In its natural position the current is simply allowed to pass by way of the instrument to the recording apparatus, and thence to the earth. When in use for the purpose of sending a message, the operator depresses the lever by means of the vulcanite handle, thus bringing the battery into action. All the required signals are made by depressing the lever for a longer or shorter period. In the receiving instrument the current from the line-wire is made to traverse two coils of insulated wire surrounding the extremities of a bar of soft iron bent into horse-shoe form, which is thus converted, so long as the current continues to flow, into an electro-magnet. The magnetic force thus established serves to draw down the iron cross-bar attached to a lever above it, thereby elevating its further extremity. At this further end of the lever is fixed a sharp steel or pencil point, which by the upward motion of the lever is brought into contact with a cylinder moved by clockwork. The clockwork also sets in motion an apparatus by means of which a narrow strip of paper, uncoiled from a reel situated over the instrument, is made to pass round the cylinder in such a way that when the lever is attracted through the action of the electro-magnet the pencil or style marks the paper with a series of dots and dashes corresponding to the short or long depressions of the lever of the transmitting instrument at the distant station. The symbols used are equal in their significance to the declinations of the needle in the instrument already described—a dot or short dash being equivalent to a left-hand declination of the needle, and a long dash to a right-hand declination.

These and other developments of the system—by means of which the several stations connected with a line are signalled and detached as occasion may require, while a number of messages can be transmitted along the same wire —have combined to render the electric telegraph one of the most remarkable as well as useful inventions the world has ever witnessed, and by means of which much of its most important business is at the present day carried on.

The systems of telegraphing just described depend upon the power of an electric current, in the one case to influence the position of a permanent magnet, and in the other to make a temporary one. On the other hand, a permanent magnet possesses the power, by means of the vibrations of a metal tympanum, of setting up an electric current in a line of wire. The knowledge of this fact has led to the invention of the Telephone, by means of which speech is audibly reproduced at the end of a line of considerable extent, and which has already proved a useful adjunct to the Electric Telegraph. *Compiled.*

ORIGIN AND PROGRESS OF THE ELECTRIC TELEGRAPH.

It has never been difficult for men to devise or interpret symbols. The great difficulty is to traverse space and time with the symbol,—to give meaning to the first four, not the last five letters, of the word *Tele-graph.*

Now the swiftness of man's foot can do much for us, and still more the swiftness of the horse or the camel. And when these fail us we can employ the wings of the carrier-pigeon; and when that flags, the steamer and the railway locomotive will take up the running for us. But all are too slow for a generation so fast as ours. Sound is so insufficient, that we use it only for short distances. And even Light, though no laggard, is stopped in its progress by the curvature of the earth's surface; besides being nearly useless as a signal at night, and totally so in fogs or cloudy weather. The only agent that will serve our purpose is Electricity. It is far swifter than sound or light. It is not afraid of the dark, and it can travel in all weathers. It can outrival even the goblin messenger in the old ballad, of whom we are told—

"And when he came to broken bridge,
He bent his bow and swam;
And when he came to grass growing,
Set down his feet and ran.
And when he came to Greenwood Hall,
Would neither knock nor call;
But set his bent bow to his breast,
And lightly leaped the wall."

The highway for this subtle spirit—which, together with the generating and propelling apparatus at the one end, and the receiving and recording instruments at the other, constitutes the Electric Telegraph—is in one sense the lineal descendant of the older methods of speaking and writing to a distance. But its purely scientific parents are the Compass-needle and the Electrical Machine.

As the guide of Columbus to the New World, the magnetic needle was the precursor and pioneer of the Telegraph. Silently, and as with finger on its lips, it led him across the waste of waters. And the time has come when, as an integrant of the Telegraph, it has removed its finger and broken silence, so that now the inhabitants of the old and the new hemispheres exchange affectionate greetings. The quivering magnetic needle which lies in the coil of the galvanometer is the tongue of the electric Telegraph, and engineers talk of it as *speaking.*

The magnet, however, did not, till 1820, directly aid the Telegraph. What, then, of the other parent? We strike sharply, in beginning, on a definite date, 1600, when Gilbert of Colchester introduced the new *word*, and the all but new science, Electricity. The science, thus recognised and titled, made rapid progress. The lump of amber was changed for a fragment of sulphur, which soon grew into a globe, and was by-and-by replaced by a glass sphere, a cylinder, or a plate, whirled rapidly, and constituting an Electrical Machine. By the beginning of the eighteenth century, men knew well how to produce electricity. And soon afterwards they discovered that some bodies *conduct*, and others do *not* conduct it; so that they were in possession of the essential halves of an electrical highway, namely, conductors free through half their length, and insulated through the other half by non-conductors.

In 1745, the Leyden Jar was stumbled on. It was literally an electrical condenser, and did as much to enhance the power of the friction-machine, as Watt's steam-condenser did to enlarge that of the steam-engine. Provided with the Leyden Jar, the next two important telegraphic discoveries were speedily made: the one that electricity traverses a metallic wire with inconceivable rapidity; the other that it travels with equal celerity through earth or water. Here, then, were two-thirds of the Telegraph supplied; the message-sender was there, and so was the message-carrier. Why was not a message-receiver also provided? The fault lay with the sender. Friction-electricity is so brief in duration, and so intense and impetuous, that it cannot be induced to take a long journey. The best conductors in their best state of insulation are unwelcome to it. If there is the least obstacle in any part of its path, it turns off, as it were, at a side-station, and returns by the shortest route with its message undelivered.

Owing to this hindrance, Electrical Telegraphy remained at a stand-still for half a century. But, in 1800, the Voltaic Battery, already some years in use, was ascertained to produce a continuous stream of electricity, far less impetuous and reluctant to travel than the electricity of the friction-machine. We had to wait, however, twenty years longer, till two famous additional discoveries were made: the one that the electrical current deflects the compass-needle; the other that the electric current develops magnetism. Our earliest Electric Telegraph was electro-magnetic; and to this day the majority of Telegraphs employ electricity to produce signals, either by moving a permanent magnet, or by making a temporary one.

The land Telegraph was now in essentials complete; but a subaqueous Telegraph was still impossible for want of a good insulator. Great historical importance, accordingly, attaches to the importation, in 1843, of gutta-percha, which, from its powerful insulating properties, has rendered it possible to lay telegraph wires across the beds of the mightiest oceans. The early attempts to lay submarine cables were attended with much difficulty and many failures. The first of these, laid in 1850 between Dover and Calais, continued to act only for a day; and that greatest achievement of electric engineering, the bringing together of the Old and New Worlds, was not successfully accomplished till three cables had been laid across the Atlantic. The first Atlantic cable was laid in 1858, but ceased to convey messages after a month. In 1865 a second was laid and lost. In 1866, however, telegraphic communication was permanently established by the successful laying of a third cable; and since then nearly all the most important parts of the world have been brought into telegraphic communication with each other, and the feat of putting an electric girdle round the globe has been virtually consummated. The existing lines include many hundred thousand miles of wire. The batteries amount to thousands, and demand a lake or river of sulphuric acid to excite them. The magnets are not less numerous than the batteries; and of lesser instruments the name is legion. The arts involved, who can patiently enumerate? Consider what felling of forests there must have been; what quarrying and dressing of metallic ores; what smelting and working of metals; what tapping of gutta-percha trees; what digging of coal and sulphur, and blazing of brimstone to make oil of vitriol; what loading of ships and guiding them safe across the seas of the world! —and all this but the preparation of the raw material! Add its elaboration and application!—the navvy work of laying lines, spinning cables, erecting posts, and otherwise fitting together the ruder components of the Telegraph; and the multiplied artistic skill in constructing batteries, dials, alarums, and other refined apparatus required upon the line! Lastly, consider how vast is the genius which our

Telegraph represents;—all that the world knows of electricity since first there was a thunderstorm; all that the world knows of magnetism since first a loadstone was seen to lift iron dust; all that the world knows of a science whose name, Chemistry, has left its first meaning in the forgotten darkness of antiquity!

Let us wish all success to the Telegraph everywhere. The best interests of the world are bound up in its progress, and its mission is emphatically one of peace. It does not speak swiftly merely, but softly; and it offers men a common speech in which all mankind can converse together.

Compiled.

SPECIMENS OF THE POETRY OF THE EIGHTEENTH CENTURY.

(*Chronologically arranged.*)

How poor, how rich, how abject, how august,
How complicate, how wonderful, is man!
How passing wonder He who made him such!
Who centred in our make such strange extremes
From different natures marvellously mixed,—
Connexion exquisite of distant worlds!
Distinguished link in being's endless chain,
Midway from nothing to the Deity!
A beam ethereal, sullied and absorbed,—
Though sullied and dishonoured, still divine!
Dim miniature of greatness absolute!
An heir of glory! a frail child of dust!
A worm! a god!—I tremble at myself,
And in myself am lost!

EDWARD YOUNG (*b.* 1681).

BUT most by numbers judge a poet's song;
And smooth or rough with them is right or wrong;
In the bright Muse though thousand charms conspire,
Her voice is all these tuneful fools admire;
Who haunt Parnassus but to please the ear,
Not mend their minds; as some to church repair,
Not for the doctrine, but the music there.
These equal syllables alone require,
Though oft the ear the open vowels tire;

While expletives their feeble aid do join,
And ten low words oft creep in one dull line:
While they ring round the same unvaried chimes
With sure returns of still expected rhymes;
Where'er you find "the cooling western breeze,"
In the next line it "whispers through the trees:"
If crystal streams "with pleasing murmurs creep,"
The reader 's threatened, not in vain, with "sleep."
Then, at the last and only couplet, fraught
With some unmeaning thing they call a thought,
A needless Alexandrine ends the song,
That like a wounded snake drags its slow length along.

ALEXANDER POPE (*b.* 1688).

OH! who can speak the vigorous joys of health,
  Unclogged the body, unobscured the mind:
The morning rises gay, with pleasing stealth,
  The temperate evening falls serene and kind.
  In health the wiser brutes true gladness find:
See! how the younglings frisk along the meads,
  As May comes on, and wakes the balmy wind;
Rampant with life, their joy all joy exceeds:
Yet what but high-strung health this dancing pleasance breeds?

I care not, Fortune, what you me deny:
  You cannot rob me of free Nature's grace;
You cannot shut the windows of the sky,
  Through which Aurora shows her brightening face;
  You cannot bar my constant feet to trace
The woods and lawns, by living stream, at eve:
  Let health my nerves and finer fibres brace,
And I their toys to the great children leave:
Of fancy, reason, virtue, nought can me bereave.

JAMES THOMSON (*b.* 1699).

GAY hope is theirs by fancy fed,
  Less pleasing when possest;
The tear forgot as soon as shed,
  The sunshine of the breast:
Theirs buxom health of rosy hue,
Wild wit, invention ever new,
  And lively cheer, of vigour born;
The thoughtless day, the easy night,

The spirits pure, the slumbers light,
  That fly the approach of morn.

Alas! regardless of their doom,
  The little victims play;
No sense have they of ills to come,
  Nor care beyond to-day:
Yet see how, all around them, wait
The ministers of human fate,
  And black Misfortune's baleful train!
Ah, show them where in ambush stand,
To seize their prey, the murderous band!
  Ah, tell them they are men!

To each his sufferings: all are men,
  Condemned alike to groan;
The tender for another's pain,
  The unfeeling for his own.
Yet ah! why should they know their fate,
Since sorrow never comes too late,
  And happiness too swiftly flies?
Thought would destroy their paradise.
No more;—where ignorance is bliss,
  'Tis folly to be wise.

THOMAS GRAY (*b.* 1716)

TURN we to survey
Where rougher climes a nobler race display,
Where the bleak Swiss their stormy region tread,
And force a churlish soil for scanty bread:
No product here the barren hills afford,
But man and steel, the soldier and his sword;
No vernal blooms their torpid rocks array,
But winter, lingering, chills the lap of May;
No Zephyr fondly sues the mountain's breast,
But meteors glare, and stormy glooms invest.
  Yet still, even here, content can spread a charm,
Redress the clime, and all its rage disarm.
Though poor the peasant's hut, his feasts though small,
He sees his little lot the lot of all;
Sees no contiguous palace rear its head,
To shame the meanness of his humble shed;
No costly lord the sumptuous banquet deal,
To make him loathe his vegetable meal;

But calm, and bred in ignorance and toil,
Each wish contracting fits him to the soil.
Cheerful at morn, he wakes from short repose,
Breathes the keen air, and carols as he goes;
With patient angle trolls the finny deep,
Or drives his venturous ploughshare to the steep;
Or seeks the den where snow-tracks mark the way,
And drags the struggling savage into day.
At night, returning, every labour sped,
He sits him down the monarch of a shed,
Smiles by his cheerful fire, and round surveys
His children's looks that brighten at the blaze;
While his loved partner, boastful of her hoard,
Displays her cleanly platter on the board;
And haply, too, some pilgrim, thither led,
With many a tale repays the nightly bed.
  Thus every good his native wilds impart,
Imprints the patriot passion on his heart;
And even those ills that round his mansion rise,
Enhance the bliss his scanty fund supplies.
Dear is that shed to which his soul conforms,
And dear that hill which lifts him to the storms;
And, as a child, when scaring sounds molest,
Clings close and closer to the mother's breast,
So the loud torrent, and the whirlwind's roar,
But bind him to his native mountains more.

OLIVER GOLDSMITH (*b.* 1728).

ROLL on, ye Stars! exult in youthful prime,
Mark with bright curves the printless steps of time.
Near and more near your beamy cars approach,
And lessening orbs on lessening orbs encroach:
Flowers of the sky! ye, too, to age must yield,
Frail as your silken sisters of the field!
Star after star from heaven's high arch shall rush,
Suns sink on suns, and systems systems crush,
Headlong, extinct, to one dark centre fall,
And death, and night, and chaos mingle all!
Till o'er the wreck, emerging from the storm,
Immortal nature lifts her changeful form,
Mounts from her funeral pyre on wings of flame,
And soars and shines, another and the same!

ERASMUS DARWIN (*b.* 1731).

HARK! 'tis the twanging horn o'er yonder bridge,
That with its wearisome but needful length
Bestrides the wintry flood, in which the moon
Sees her unwrinkled face reflected bright;—
He comes, the herald of a noisy world,
With spattered boots, strapped waist, and frozen locks;
News from all nations lumbering at his back.
True to his charge, the close-packed load behind,
Yet careless what he brings, his one concern
Is to conduct it to the destined inn,
And, having dropped the expected bag, pass on.
He whistles as he goes, light-hearted wretch,
Cold and yet cheerful: messenger of grief
Perhaps to thousands, and of joy to some;
To him indifferent whether grief or joy.
Houses in ashes, and the fall of stocks;
Births, deaths, and marriages; epistles wet
With tears that trickled down the writer's cheeks,
Fast as the periods from his fluent quill,
Or charged with amorous sighs of absent swains,
Or nymphs responsive, equally affect
His horse and him, unconscious of them all.
But, oh, the important budget! ushered in
With such heart-shaking music,—who can say
What are its tidings? Have our troops awaked?
Or do they still, as if with opium drugged,
Snore to the murmurs of the Atlantic wave?
Is India free? and does she wear her plumed
And jewelled turban with a smile of peace,
Or do we grind her still? The grand debate,
The popular harangue, the tart reply,
The logic, and the wisdom, and the wit,
And the loud laugh,—I long to know them all;
I burn to set the imprisoned wranglers free,
And give them voice and utterance once again.

WILLIAM COWPER (*b.* 1731).

WHAT constitutes a State?
  Not high-raised battlement, or laboured mound,
Thick wall, or moated gate;
  Not cities proud, with spires and turrets crowned;
Not bays and broad-armed ports,
  Where, laughing at the storm, proud navies ride;

Nor starred and spangled courts,
  Where low-browed Baseness wafts perfume to Pride!
No! men, high-minded men,
  With powers as far above dull brutes endued,
In forest, brake, or den,
  As beasts excel cold rocks and brambles rude:
Men, who their duties know,
But know their rights, and, knowing, dare maintain.
SIR WILLIAM JONES (*b.* 1746).

SECTION VI.

THE BRITISH CONSTITUTION.

IN England the supreme government is divided into two branches—the one *legislative*, consisting of king, lords, and commons; the other *executive*, consisting of the king alone.

The executive or regal office is hereditary on certain conditions; but the right of inheritance may be changed or limited by act of parliament. The principal duty of the king is to govern the people according to the laws; "for although the king," says Lord Bacon, "is the fountain of justice, and is intrusted with the whole executive power of the law, yet he hath no power to change or alter the laws which have been received and established in these kingdoms, and are the birthright of every subject; for it is by those very laws that he is to govern." The king owns no superior but God and the laws. It is a maxim of the constitution, that the king in his political capacity *can do no wrong*, because he acts only by officers responsible to the law. It is another maxim of the constitution that the king *never dies;* or, in other words, that the executive authority never ceases to exist. The king is head upon earth of the English Church; but he cannot alter the established religion. He is also generalissimo of all the forces; but he cannot raise an army without the consent of parliament, nor can he maintain it without that consent being renewed from year to year. He has the power of coining money, but he cannot alter the standard. He has the power of summoning, proroguing, or dissolving the parliament; but he is bound to summon a new parliament at least every seven years. He is also bound to administer justice in the established course in his courts of law, not as a free gift, but as the due of his people. He is, however, the sole representative of his people with foreign states, having the power of sending ambassadors, concluding treaties of alliance, and making peace or war. The king is also the fountain of mercy; he alone can pardon all public offences, either absolutely or conditionally; and he is, moreover, the fountain of honour, as the constitution has intrusted him with the sole power of conferring titles, dignities, and honours.

The *legislative* authority is vested in a parliament, consisting of the sovereign, the lords spiritual and temporal, and the commons. The House of Lords consists of two archbishops and twenty-four bishops of the Episcopal Church of England, and of about five hundred peers who are entitled to seats by inheritance, creation, or election. The House of Commons consists of six hundred and fifty-two persons, who are returned by the counties, universities, cities, and boroughs possessing the right of election. Of these, four hundred and eighty nine are returned by England, one hundred and three by Ireland, and sixty by Scotland. Though delegated by particular places, they are bound as members of parliament to act for the general good of the country. Their principal duties are to check and reform abuses of the administration —to redress public and private grievances—to watch over the public revenue and expenditure—to enforce, by their power of inquiry and impeachment, a pure administration of justice in all departments—to assist in framing wise laws, —and, finally, to preserve and promote, by every constitutional means, the peace, freedom, and prosperity of the people. The powers and privileges of this part of the legislature are commensurate to its great importance in the government. The Commons possess the sinews of war; they are the [illegible]epers of the public purse; and all grants, subsidies, and taxes, must originate with them. By their power of withholding supplies, they have a strong control over the executive; and by the constitution they enjoy all the privileges necessary to the full and free discharge of their high functions. Though new laws may be proposed by any member of either house, the consent of all the three constituent parts of the legislature is necessary to make laws binding on the subject; and though any part of the legislature may, by withholding its consent, prevent the enactment of a law, it requires the agreement of all the three to repeal an existing statute.

"Thus," as observed by Blackstone, "the true excellence of the British government consists in all its parts forming a mutual check upon each other. The legislature cannot abridge the executive power of any rights which it has by law, without its own consent. The commons are a check upon the nobility, and the nobility are a check upon the commons, by the mutual privilege of rejecting what the other has resolved; while the king is a check upon both; which preserves the executive power from encroachment. And this very executive power is again checked, and kept within due bounds, by the two houses, through the privilege they have of inquiring into, impeaching, and punishing the conduct, not indeed of the king (which would destroy his constitutional independence), but of his evil and pernicious counsellors."

ENGLAND PAST AND PRESENT.

Of a truth, whosoever had, with the bodily eye, seen Hengist and Horsa mooring on the mud-beach of Thanet, on that spring morning of the year 449, and then, with the spiritual eye, looked forward to New York, Calcutta, Sydney Cove, across the ages and the oceans, and thought what Wellingtons, Washingtons, Shakspeares, Miltons, Watts, Arkwrights, William Pitts, and Davie Crocketts had to issue from that business, and do their several taskworks so,—*he* would have said these leather boots of Hengist's had a kind of cargo in them—a genealogic mythus, superior to any in the old Greek—and not a mythus either, but every fibre of it fact.

CARLYLE.

PLACE before your eyes the island of Britain in the reign of Alfred—its unpierced woods, its wide morasses and dreary heaths, its blood-stained and desolate shores, its untaught and scanty population—behold the monarch listening now to a Bede and now to John Erigena; and then see the same realm a mighty empire, full of motion, full of books, where the cottar's son, twelve years old, has read more than archbishops of yore, and possesses the opportunity of reading more than our Alfred himself. COLERIDGE.

THE history of England is emphatically the history of progress. It is the history of a constant movement in the public mind, of a constant change in the institutions of a great society. We see that society, at the beginning of the twelfth century, in a state more miserable than the state in which the most degraded nations of the East now are. We see it subjected to the tyranny of a handful of armed foreigners. We see a strong distinction of caste separating the victorious Norman from the vanquished Saxon. We see the great body of the population in a state of personal slavery. We see the multitude sunk in brutal ignorance, and the studious few engaged in acquiring what did not deserve the name of knowledge. In the course of seven centuries the wretched and degraded race have become the greatest and most highly civilized people that ever the world saw—have spread their dominion over every quarter of the globe—have scattered the seeds of mighty empires and republics over vast continents, of which no dim intimation had ever reached Ptolemy or Strabo—have created a maritime power which would annihilate in a quarter of an hour the navies of Tyre, Athens, Carthage, Venice, and Genoa together—have carried the science of healing, the means of locomotion and correspondence, every mechanical art, every manufacture, everything that promotes the convenience of life, to a perfection which our ancestors would have thought magical—have produced a literature which may boast of works not inferior to the noblest which Greece has bequeathed to us—have discovered the laws which regulate the motions of the heavenly bodies—have speculated with exquisite subtlety on the operations of the human mind—have been the acknowledged leaders of the human race in the career of political improvement.

MACAULAY.

IF nature has denied to Britain the fruitful vine, the fragrant myrtle, and the beautiful climate, she has also exempted her from the parching drought, the deadly siroc, and the frightful tornado. If our soil is poor and churlish, and our skies cold and frowning, the serpent never lurks within the one, nor the plague within the other. If our mountains are bleak and barren, they have at least nursed within their bosoms a race of men whose industry and intelligence supply a more inexhaustible fund of wealth than all the mines of Mexico and Hindostan. If other nations furnish us with the materials of our manufactures, ours are the skill and industry that have enhanced their value a thousandfold; ours are the capital and enterprise that have applied the great inventions of Watt and Arkwright, and made the ascendency of this little island be felt in the remotest corners of the world; ours, in a word, are those institutions, civil, political, and religious, that have made us the envy of surrounding nations and raised us to a pinnacle of greatness from which nothing but intestine foes can ever thrust us down. M'DIARMID.

WE rest in the confident belief, that England, in despite of her burdens and her disadvantages, will maintain her commercial pre-eminence among the nations of the world, provided only she can also maintain, or rather also elevate, the moral and spiritual life of her own children within her borders. Her material greatness has grown out of her social and religious soundness, and out of the power and integrity of individual character. It is well to talk of our geographical position; but this does not alone make a nation great in industrial pursuits. There is our mineral wealth; not so much, probably, greater than that of other lands, as earlier extracted and employed; and whence proceeded that earlier extraction and application? There is our capital, the fruit of our accumulated industry; why does this exceed the capital of other nations, but because there was *more* industry, and therefore more accumulation? There are our inventions; they did not fall upon us from the clouds like the Ancilia of Rome; they are the index and the fruit of powerful and indefatigable thought applied to their subject-matter. It is in the creature MAN, such as God has made him in this island, that the moving cause of the commercial pre-eminence of the country is to be found; and his title to that pre-eminence is secure, if he can in himself but be preserved, or even rescued from degeneracy. GLADSTONE.

ADVERSITY.

THE path of sorrow, and that path alone,
Leads to the land where sorrow is unknown,
No traveller ever reached that blessed abode,
Who found not thorns and briers in his road.
For He who knew what human hearts would prove,
How slow to learn the dictates of His love—
That hard by nature and of stubborn will,
A life of ease would make them harder still—
In pity to the souls His grace designed
To rescue from the ruin of mankind,
Called for a cloud to darken all their years,
And said, "Go spend them in a vale of tears."

COWPER.

BEHOLD this vine:
I found it a wild tree, whose wanton strength
Had swollen into irregular twigs
And bold excrescences,
And spent itself in leaves and little rings--
So, in the flourish of its outwardness,
Wasting the sap and strength
That should have given forth fruit.

But when I pruned the tree,
Then it grew temperate in its vain expanse
Of useless leaves, and knotted, as thou seest,
Into these full, clear clusters, to repay
The hand that wisely wounded it.
Repine not, O my son!
In wisdom and in mercy, Heaven inflicts,
Like a wise leech, its painful remedies.
If ye would know
How visitations of calamity
Affect the pious soul, 'tis shown ye there!
Look yonder at that cloud, which, through the sky
Sailing alone, doth cross in her career
The rolling moon! I watched it as it came,
And deemed the deep opaque would blot her beams;
But, melting like a wreath of snow, it hangs
In folds of wavy silver round, and clothes
The orb with richer beauties than her own;
Then, passing, leaves her in her light serene.

SOUTHEY.

WITHIN this leaf, to every eye
So little worth, doth hidden lie
Most rare and subtle fragrancy.
Wouldst thou its secret strength unbind?
Crush it, and thou shalt perfume find,
Sweet as Arabia's spicy wind.
In this dull stone, so poor and bare
Of shape or lustre, patient care
Will find for these a jewel rare.
But first must skilful hands essay
With file and flint to clear away
The film which hides its fire from day.

This leaf? this stone? It is thy heart!
It must be crushed by pain and smart,
It must be cleansed by sorrow's art,
Ere it will yield a fragrance sweet,
Ere it will shine a jewel meet
To lay before thy dear Lord's feet.

BISHOP WILBERFORCE.

"GET thee back, Sorrow, get thee back!
  Why should I weep while I am young?
I have not piped, I have not danced,
  My morning songs I have not sung;
The world is beautiful to me—
  Why tarnish it to soul and sense?—
Prithee, begone! I'll think of thee
  Some half-a-hundred winters hence."—

"O foolish Youth! thou knowest me not;
  I am the mistress of the earth;
'Tis I give tenderness to love,
  Enhance the privilege of mirth,
Refine the human gold from dross,
  And teach thee, wormling of the sod!
To look beyond thy present loss
  To thy eternal gain with God."—

"Get thee back, Sorrow, get thee back!
  I'll learn thy lessons soon enough;
If virtuous pleasure smooth my way,
  Why shouldst thou seek to make it rough?—
No fruit can ripen in the dark,
  No bud can bloom in constant cold,—
So prithee, Sorrow, miss thy mark,
  Or strike me not till I am old!"—

"I am thy friend, thy best of friends;
  No bud in constant heats can blow;
The green fruit withers in the drought,
  But ripens where the waters flow:
The sorrows of thy youthful day
  Shall make thee wise in coming years;
The brightest rainbows ever play
  Above the fountains of our tears."

Youth frowned, but Sorrow gently smiled;
  Upon his heart her hand she laid,
And all its hidden sympathies
  Throbbed to the fingers of the Maid.
And when his head grew gray with Time,
  He owned that Sorrow spoke the truth,
And that the harvest of his prime
  Was ripened by the rains of Youth.

MACKAY

PARALLEL BETWEEN PLANTS AND ANIMALS.

Although vegetables and animals certainly belong to different kingdoms of organic life, yet there are not a few respects in which a parallel may be traced between them.

Both are, in the first instance, composed of the same materials. The simple substances—carbon, hydrogen, oxygen, nitrogen, sulphur, phosphorus—enter into the composition of plants as well as of animals. The sole distinction is that these substances are in somewhat different proportions, and assume somewhat different states of composition.

The elements of the structure both of vegetable and of animal forms are also the same. Both commence in a simple primary cell—an exceedingly minute point, yet having a well-defined circular or oval form, and in most cases a central and more compact nucleus. In this cell a special centre of force is manifested, whence proceeds a series of operations; such as the attraction of new matter from without, the assimilation of this matter into the substance of the cell, the formation of similar cells, and, finally, the development of the tissues, organs, and specific form of the plant or animal.

Nor are the external agencies essential to the vegetative and the animal life in any respect different. Air, water, heat, light, are as indispensable for the functions of the plant as of the animal.

If we proceed a little further, we have motion even in plants. We have the opening and the shutting of leaves and petals during the vicissitudes of day and night—the spiral twisting of tendrils round any neighbouring object for support—the shrinking of the leaves of the sensitive plant—and the closing of the valves of the fly-trap. Nay, we have many processes which look as like as possible to some of the so-called instinctive acts of animals. Thus, the potato, vegetating in the dark cellar, sends its long blanched rootlet over many an inch of space, till it reaches the little hole through which shine a few rays of the all-attractive sun; and in this progress it will creep round, or boldly climb over and surmount, any opposing obstacle. When a pole is placed at a considerable distance from an unsupported vine—the branches of which are proceeding in a contrary direction from the pole—the vine will, in a very short time, alter its course, and will not stop till it has wound its tendrils firmly round the pole; yet the same vine will carefully avoid attaching itself to low vegetables nearer to it, such as the cabbage. If we inspect a field of wheat or barley a few days after the plants have come above ground, it will be found, on digging up the plants, that every second or third seed, when sown, had fallen with the germinating end downwards; yet no sooner had germination commenced, than the minute leaf-bud, twisting round, took an upward course into the air and sun, while, on the other hand, the rootlet, deviating from its upward position, plunged with all speed into the dark moist soil.

Plants, like animals, show a wonderful tenacity of life, even under most unfavourable circumstances. Cut down vines and hops ever so much, and the cutting but becomes a stimulus to renewed vigour. Pope, the poet, on receiving a basket of figs from the Levant, discovered a portion of the basket already budding into vegetation; he planted the twig, and thence proceeded the first Babylonian or weeping willow that grew in England. Nor are the germs of plants, treasured up in the seeds, less retentive of life. It is reported that seeds of wheat have been taken from Egyptian mummy-cases, at least two thousand years old, and that, on being put into the ground, they have vegetated.

Plants, too, like animals, are gregarious. We find clusters of certain species associated together, and very seldom do we meet with solitary or isolated plants. At certain seasons of the year, we find the forest glades, or the open meadows, gay with one particular kind of red, or blue, or yellow flower. Yet this gregarious propensity has its check and limits, else we should have the most prolific and vigorous plants extending so as to exclude all the more delicate from the surface of the soil. Where a number of plants of the same species crowd and grow together for a year or two, the soil becomes exhausted of the particular proportions of nutritious matter on which the species chiefly feed, and thus they die out from mere starvation. It is for this reason that we find the broom, laburnum, and common oat, with their pericarps so arranged as, in due time, when the seed within is matured, to open with a sudden jerk, and thus scatter the seeds to a distance from the parent stock: while other seeds, again, as the thistle and dandelion, are furnished with a buoyant *pappus* or downy appendage, which enables them to float along with every gale of wind till they are carried far from home, and into new and untried fields and valleys.

It may seem rather fanciful to add—though it is true—that plants have often as many and strange adventures as animals. What, for instance, can be more wonderful than the travels of many seeds borne on the wind over mountains and valleys, till at last they find a home amid strange forms and unknown species; or the voyage of the cocoa-nut in the Pacific, floating on over hundreds of miles of ocean, with only now and then the whirling sea-bird pouncing down to peck at it with his bill, till at last a coral reef is attained. A little crumbling coral dust and the remains of decayed sea-weed are sufficient to form a soil whence a tall palm grows; and then another, and another succeeds—the reef increases to a considerable island—and at last groups of tawny natives assemble in its shady groves, quaffing the delicious juice of the half-ripened nuts, and dancing and singing till the lonely ocean for many a league resounds with their lively glee. . .

Abridged from the BRITISH QUARTERLY REVIEW.

APOPHTHEGMS.

REASON cannot show itself more reasonable, than to leave reasoning on things above reason.—SIR PHILIP SIDNEY.

Passions are likened best to floods and streams;
The shallow murmur, but the deep are dumb;
So, when affections yield discourse, it seems
The bottom is but shallow whence they come.

SIR WALTER RALEIGH.

One touch of nature makes the whole world kin.
SHAKSPEARE.

The use of poesy is to give some shadow of satisfaction to the mind of man in those points wherein the nature of things doth deny it. Therefore, because the acts or events of true history have not that magnitude which satisfieth the mind, poesy feigneth acts and events greater and more heroical; because true history propoundeth the successes and issues of actions not so agreeable to the merits of virtue and vice, therefore poesy feigns them more just in retribution, and more according to revealed providence; because true history representeth actions and events more ordinary and less interchanged, therefore poesy endueth with more rareness and more unexpected and alternative variations. So it appeareth that poesy serveth and conferreth to magnanimity, to morality, and to delectation. And therefore it was ever thought to have some participations of divineness.—BACON.

Reading maketh a full man; conference a ready man; and writing an exact man.—*Id.*

Heaven's gates are not so highly arched
As princes' palaces; they that enter there
Must go upon their knees. WEBSTER.

Only the actions of the just
Smell sweet, and blossom in the dust. SHIRLEY.

Sleep is death's younger brother, and so like him, that I never dare trust him without my prayers.—SIR T. BROWNE.

The house of correction is the fittest hospital for those cripples whose legs are lame through their own laziness.—FULLER.

Hypocrisy is a sort of homage that vice pays to virtue.—*Id.*

As good almost kill a man as a good book. A good book is the precious life-blood of a master-spirit, embalmed and treasured up on purpose to a life beyond life.—MILTON.

The mind is its own place, and in itself
Can make a heaven of hell, a hell of heaven.—*Id.*

Peace hath her victories
Not less renowned than war.—*Id.*

No man is so insignificant as to be sure his example can do no hurt.—CLARENDON.

Sleep is a god too proud to wait in palaces,
  And yet so humble, too, as not to scorn
The meanest country cottages:
  His poppy grows among the corn. COWLEY.

What men want of reason for their opinions, they usually supply and make up in rage.—TILLOTSON.

Strange cozenage! None would live past years again;
Yet all hope pleasure in what yet remain;
And from the dregs of life think to receive
What the first sprightly running could not give.—DRYDEN.

The truest characters of ignorance
Are vanity, and pride, and arrogance;
As blind men use to bear their noses higher,
Than those that have their eyes and sight entire.—BUTLER.

"Love covers a multitude of sins." It is like the painter who, being to draw the picture of a friend having a blemish in one eye, would picture only the other side of his face.—SOUTH.

Though a soldier in time of peace is like a chimney in summer, yet what wise man would pluck down his chimney because his almanac tells him 'tis the middle of June?—TOM BROWN.

The poets give immortality to none but themselves; it is Homer and Virgil we admire, not Achilles or Æneas. With the historians it is quite the contrary; our thoughts are taken up with the actions, persons, and events, and we little regard the authors.—SWIFT.

Ambition often puts men upon doing the meanest offices; so climbing is performed in the same posture with creeping. —*Id.*

'Tis not in mortals to command success,
But we'll do more, Sempronius—we'll deserve it.—ADDISON.

Human nature is not so much depraved as to hinder us from respecting goodness in others, though we ourselves want it. —STEELE.

Think nought a trifle, though it small appear;
Small sands the mountain, moments make the year,
And trifles life. YOUNG.

He who tells a lie is not sensible how great a task he undertakes; for he must be forced to invent twenty more to maintain that one.—POPE.

One self-approving hour whole years outweighs
Of stupid starers and of loud huzzas.—*Id.*

Hope springs eternal in the human breast,
Man never *is*, but always *to be* blest.—*Id.*

Loveliness
Needs not the foreign aid of ornament,
But is, when unadorned, adorned the most.—THOMSON.

No man can improve in any company for which he has not respect enough to be under some degree of restraint.—LORD CHESTERFIELD.

The difference there is betwixt honour and honesty seems to be chiefly the motive: the honest man does that from duty which the man of honour does for the sake of character.—SHENSTONE.

The morality of an action depends upon the motive from which we act. If I fling half-a-crown to a beggar with intention to break his head, and he picks it up and buys victuals with it, the physical effect is good; but with respect to me the action is very wrong.—JOHNSON.

He is happy whose circumstances suit his temper; but he is more excellent who can suit his temper to any circumstances.—HUME.

How small of all that human hearts endure
That part which laws or kings can cause or cure.
GOLDSMITH.

I would not have a slave to till my ground—
To carry me, to fan me while I sleep,
And tremble when I wake—for all the wealth
That sinews bought and sold have ever earned.
No! dear as freedom is, and in my heart's
Just estimation prized above all price,
I had much rather be myself the slave,
And wear the bonds, than fasten them on him.—COWPER.

Seven hours to law, to soothing slumber seven,
Ten to the world allot, and all to Heaven.
SIR WILLIAM JONES.

Upon thy mother's knee, a new-born child,
Weeping thou sat'st, whilst all around thee smiled;
So live, that, sinking into death's long sleep,
Calm thou mayst smile, while all around thee weep!—*Id.*

It is the duty [of your parliamentary representative] to sacrifice his repose, his pleasures to yours, and, above all, to prefer in all cases your interest to his own. But his unbiassed opinion, his mature judgment, his enlightened conscience, he ought not to sacrifice to you, to any man, or to any set of men living. These he does not derive from your pleasure; no, nor from the law and the constitution. They are a trust from Providence, for the abuse of which he is deeply responsible.—BURKE.

There is no use of money equal to that of beneficence: here the enjoyment grows on reflection, and our money is most truly ours when it ceases to be in our possession.—MACKENZIE.

The rank is but the guinea's stamp,
The man 's the gowd for a' that. BURNS.

If you would have a faithful servant, and one that you like, serve yourself.—FRANKLIN.

O woman! in our hours of ease,
Uncertain, coy, and hard to please,
And variable as the shade
By the light quivering aspen made;
When pain and anguish wring the brow,
A ministering angel thou! SIR WALTER SCOTT.

A thing of beauty is a joy for ever. KEATS.

Light itself gives a shadow; and, in this imperfect state, every good seems to bring into play some evil.—SOUTHEY.

Religion is the basis upon which civil government rests, —that from which power derives its authority, laws their efficacy, and both their sanction.—*Id.*

The miracles performed by Christ were the ringing of the great bell of the universe to announce the sermon that was to follow.—FOSTER.

The man who is perplexed by religious doubts, should be advised to cure himself, not by the physic of reading and controversy, but by the diet of holy living.—KEBLE.

Religion is a thousand-voiced psalm from the heart of man to his invisible Father.—CARLYLE.

RAIN.

THE due irrigation of the earth is a point of vital importance to all its inhabitants, vegetable and animal. The machinery by which this is accomplished is complex, and in some respects extremely recondite; but, viewed as a great apparatus for pumping up water and sprinkling the surface of our planet, it is manifestly a most effective contrivance.

The magnificent process of evaporation is the first step which is taken. Since water is a fluid many times heavier than air, it requires to be so changed as to render it portable through the atmosphere. This object is accomplished by converting it into vapour through the agency of heat. And happily almost any degree of heat is sufficient for the purpose. The higher the temperature, indeed, the more rapid is the evaporation; but water gives out vapour at every stage of temperature, though at a tardier rate, and of feebler tension.

Of course, the great sheets of water on the globe are the reservoirs from which supplies of vapour are primarily extracted. Dr Halley calculated that the quantity yielded by the Mediterranean alone, during twelve hours of a summer's day, amounted to 5,280,000,000 tons. The moisture exhaled from the land must necessarily vary with the humidity as well as the temperature of the spot; but from experiments made under different circumstances, it has been estimated that a British acre yields from 2000 to 3000 gallons in twelve hours. And not only does the ground perspire thus freely, but vegetables, also, and animals are extremely sudorific. Dr Halley found that some cabbages, which were subjected to experiment, gave off 1 lb. 3 oz. during the day, while some sun-flowers threw out 1 lb. 4 oz. Men, too, are constantly discharging moisture into the atmosphere. Not less than 2 lbs. of aqueous vapour are daily expelled from the skin and lungs of most individuals; and if a person happens to be flung into a particularly deliquescent mood by heat or exercise, he may contribute 5 lbs. within the four-and-twenty hours. It has been computed that the total quantity of water poured into the air every year would fill a cistern 100,000 cubic miles in capacity.

The next step is to provide for the wide dispersion over the earth's surface of the aqueous particles thus exhaled from sea and land. For this purpose the atmosphere is traversed by winds, which load themselves with the watery vapour, and hurry it off in various directions. A water-cart, filling with liquid at a reservoir, is not more explicit in its mission than a current of air, which takes in a load of vapour at the great ocean tank, and then hastens into the heart of a continent to deposit its beneficent burden. There are winds, like the Harmattan of the desert, which seem to go forth only to wither and destroy—which greedily suck up all the moisture from the land, and blight the foliage so that it crumbles into dust—but the sea-winds come charged with rich stores of humidity, and visit the land only to refresh and fertilize it.

But how is a mass of moisture, floating at a height of from two to four miles in the air, to be got down from the skies? Well, the quantity of water which can be sustained in the air in an elastic, invisible form is proportionate to the temperature. The higher the thermometer, the greater is the priming of moisture required. It is found that at 80° the dose of vapour which the air will carry is sufficient to balance an inch of the quicksilver in the barometer tube; that at 71° it is equal to three-fourths of an inch, at 59° to half an inch, and at 39° to a quarter of an inch. If, therefore, any current of air heated to 80°, starting on its journey with a full cargo of vapour, should be deprived of nine degrees of caloric, it must throw overboard one-fourth of its load, or, if reduced by twenty-one degrees, one-half. Its tonnage, we may say, is lessened by every decrement of heat. The discarded moisture will then appear in a visible shape, and, if sufficiently condensed, may descend in the form of rain.

When vapour transported from a distant sea has thus been reconverted into a liquid, there is a further necessity that its precipitation should be conducted with considerable caution. As a cloud is a great cistern containing thousands of tons of fluid, it is clear that if this were all liberated at once it would inflict serious damage on the vegetation below. The crops would be beaten to the ground, the leaves would be stripped from the trees, and a forest left standing under bare poles, like a ship whose canvass had been wrenched from its masts by an unexpected gale. In cities, too, as well as in the country, the approach of a nimbus would be eyed with alarm, and men would have to flee to buildings for shelter, since umbrellas, though made of sheet-iron, would afford but doubtful protection. There are cases of violent discharge which show what mischief might constantly ensue were not the breaking up of a cloud carefully regulated. Land-spouts, for example, occasionally tear up the ground down to the rocks below, and leave fearful chasms. Vastly more gentle, however, is the process by which the contents of an ordinary cloud are conveyed to the soil. Instead of descending in a sheet, the water trickles through the air in tiny drops, as if it had passed through some finely perforated sieve. The fluid is powdered, so to speak, in order that it may scatter itself over a large area, and alight without ruffling a leaf or crushing a blade of grass. Softly the work commences, softly it continues, as the cloud-cistern sails slowly over field after field, leaving no part untouched, but moistening every vegetable, from the idle thistle to the kingly oak.

The fall of rain, it is true, is by no means equal at all places of the earth. There are some tropical tracts where it rarely, if ever, rains. In the land of the Pharaohs, a shower is almost as great a curiosity as a land-spout or a fall of meteoric stones would be with us. In Peru, you need never unfurl an umbrella, except, perhaps, once or twice in a long lifetime. Still, deducting a few local exceptions, we find that Nature has provided for the due watering of the earth according to the requirements of climate and geographical position. As a general rule, the quantity of rain decreases as we advance from the equator to the poles; and it also decreases as we travel from the shores of a continent into the interior, or, in other words, as we recede from the great nursery of vapour. In this way the western coast of our island receives a more liberal soaking than the eastern; the huge Atlantic producing a larger amount of vapour than the petty German Ocean. The rain-fall in the eastern half of Great Britain is only 27 inches in the year, while in the western half it is from 50 to 55 inches. In a mountainous region, the precipitation of moisture increases as you ascend from the plain to the peak; but, in districts away from the hills, the rain appears to increase in quantity as it approaches the earth; nor is the difference between the fall at the foot of a tower, for example, and the fall at its top inconsiderable. One of Dr Heberden's gauges on the roof of Westminster Abbey indicated a fall of 12 inches, while another at the base showed 22, or nearly twice as much. It should be added, that the quantity of rain in any particular region may be great, while the number of rainy days is comparatively limited. Within the tropics, where the clouds are most prodigal in their effusions, there are regular seasons of dryness when the natives cannot reasonably expect any showers; but, in the temperate zones, an almanac-maker might safely book a shower for almost any day in the calendar. In England it seems that you ought to be waterproof, on an average, for 154 days of the 365; in the Netherlands for 170; in the east of Ireland for 208; whilst in Siberia it rains only one day in six, and in the north of Syria, only one in seven.

Looking, then, at water as the great agent of fertility, we ask whether the arrangements made for its regular distribution are not singularly felicitous? Long ago, the land would have been totally drained, and every river would have run itself dry, had there been any flaw in the machinery by which the floods are uplifted from their beds, and restored in needful quantities to the soil. But nature's gigantic water-works are never at fault. Every year whole lakes are hoisted into the atmosphere, and lowered with such exquisite precision, that seedtime and harvest, the former and the latter rain, are certain to arrive in due succession. The sea is ever labouring for the land. The traffic between the billow and the furrow is conducted by the ministry of the clouds. Pleasant to think of these beautiful carriers of moisture! Filled, as it were, by invisible hands at the storehouses of vapour, they catch the breeze, and make for the shore, where they deliver their load; some on the plains, that the fields may rejoice in the refreshing shower; some on the mountain-slopes, that the brooks and streams may be fed; and then the surplus fluid is rolled off to the ocean, only that it may return with generous obstinacy, and thus pursue its never-tiring rounds.

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CLOUDS, MISTS, FOG, SNOW, HAIL, AND DEW.

IT has been already mentioned, that water exposed to the air is gradually converted into vapour, which, on account of its specific levity, ascends into the atmosphere. This vapour, when held in solution by the air, is invisible, just as salt dissolved in water is invisible; but when the vapour condenses, the watery particles become visible, not only in the form of rain, as described in the preceding lesson, but also in various other forms which now fall to be briefly noticed.

Clouds are visible collections of minute globules of water suspended in the atmosphere. They vary greatly in size and shape, according to the quantity of vapour of which they are composed, and the direction and force of the wind; and they receive various names, according to their contour and aspect. A cloud composed of curling fibres or wisps, in appearance like a lock of hair, is called *cirrus;* it is the most elevated of the clouds, and is vulgarly known as "mares' tails." A cloud composed of dense, convex heaps, with rounded or rock-like summits, and a horizontal base, is called *cumulus;* it is the cloud of day. *Stratus*, the lowest of the clouds, is an extended, continuous, level sheet; it forms at sunset, and is the cloud of night. *Nimbus* is the rain-cloud; it is dense, and of a uniform black or gray tint; and its form is that of a horizontal sheet with fringed edges. The height of clouds is also very various. In ascending to the summit of mountains, the traveller frequently passes through a zone of clouds, and beholds the vesicular vapours stretched under his feet like a vast plain covered with snow; but even on the loftiest peaks of the Andes, there are always to be seen, at an immense height, certain whitish clouds resembling flakes of wool.

Mists differ from clouds only in occupying a lower elevation; and *Fog* is vapour resting on the surface of the land or water. Every one must have observed that in the morning the surface of rivers and lakes is frequently covered with fog, while the adjoining country has a clear atmosphere. The reason of this difference is, that during the night the water has a higher temperature than the air. The stratum of air in immediate contact with the water becomes heated by the water, and rises in consequence, till it meets with the cold air above, when it is cooled, and its moisture precipitated. Such fogs are soon dislodged by the heat of the sun, which elevates the temperature of the air, and renders it capable of supporting the vapour.

Snow consists of aqueous vapour congealed, either while falling, or when in the air previous to falling. The first crystals, produced at a great height in the atmosphere, determine, as they descend, the crystallization of other aqueous particles, which, without their presence, the surrounding air would retain in a state of solution. The result is the formation of hexagonal darts, or star-like crystals of six rays, when the weather is calm, and the temperature not too high to deform the crystals by melting off their angles. But when the atmosphere is agitated, and the snow falls from a great height, the crystals clash together, unite in groups, and form irregular flakes.

Hail is a species of snow or snowy rain which has undergone a succession of congelations and superficial meltings in its passage through different zones of the atmosphere of different temperatures. Its formation is supposed to depend to some extent upon electricity;—a supposition which receives support from the fact that thunderstorms are often accompanied by a fall of hailstones.

Of all the aqueous forms none is more beautiful than *Dew*,

—the moisture insensibly deposited from the atmosphere on the surface of the ground. It was long supposed that its precipitation was owing to the cooling of the atmosphere towards evening, which prevented it from retaining so great a quantity of watery vapour in solution as during the heat of the day; but Dr Wells has satisfactorily proved that the deposition of dew is produced by the cooling of the surface of the earth, which, he has shown, takes place previously to the cooling of the atmosphere. The earth is an excellent radiator of caloric, whilst the atmosphere does not possess that property in any sensible degree. Towards evening, therefore, when the solar heat declines, and after sunset, when it entirely ceases, the earth rapidly cools by radiating heat towards the skies, while the air has no means of parting with its heat but by coming into contact with the cooled surface of the earth, to which it communicates its caloric. Its solvent power being thus reduced, it is unable to retain so large a portion of watery vapour, and deposits those pearly drops called dew.

This view of the matter explains the reason why dew falls more copiously in calm than in stormy weather, and in a clear than in a cloudy atmosphere. Accumulations of moisture in the atmosphere not only prevent the free radiation of the earth towards the upper regions, but themselves radiate towards the earth; whereas, in clear nights, the radiation of the earth passes without obstacle through the atmosphere to the distant regions of space, whence it receives no caloric in exchange. The same principle enables us to explain the reason why a bottle of wine taken fresh from the cellar (in summer particularly) will soon be covered with dew. The bottle, being colder than the surrounding air, absorbs caloric from it; the moisture, therefore, which that air contained becomes visible, and forms the dew which is deposited on the bottle. In like manner, in a warm room, or in a close carriage, the inside of the windows is covered with vapour, because the window, being colder than the breath, deprives it of part of its caloric, and by this means converts it into watery vapour.

Bodies attract dew in proportion as they are good radiators of caloric, as it is this quality which reduces their temperature below that of the atmosphere. Hence, we find, that little or no dew is deposited on rocks, sand, or water; while grass and living vegetables, to which it is so highly beneficial, attract it in abundance,—a remarkable instance of the wise and bountiful dispensations of Providence. The same benevolent design we may observe also in the abundance of dew in summer and in hot climates, where its cooling effects are so much required. The more caloric the earth receives during the day, the more it will radiate afterwards; and, consequently, the more rapidly its temperature will be reduced in the evening, in comparison to that of the atmosphere. In the West Indies, accordingly, where the intense heat of the day is strongly contrasted with the coolness of the evening, the dew is prodigiously abundant. When dew is frozen the moment it falls, it gets the name of *hoar-frost.*

Compiled.

THE CLOUD.

I BRING fresh showers for the thirsting flowers,
From the seas and the streams;
I bear light shade for the leaves when laid
In their noon-day dreams.
From my wings are shaken the dews that waken
The sweet birds every one,
When rocked to rest on their mother's breast,
As she dances about the sun.
I wield the flail of the lashing hail,
And whiten the green plains under;
And then again I dissolve it in rain,
And laugh as I pass in thunder.

I sift the snow on the mountains below,
And their great pines groan aghast;
And all the night 't is my pillow white,
While I sleep in the arms of the blast.
Sublime on the towers of my skyey bowers,
Lightning, my pilot, sits;
In a cavern under is fettered the thunder—
It struggles and howls at fits;

Over earth and ocean, with gentle motion,
This pilot is guiding me,
Lured by the love of the genii that move
In the depths of the purple sea.

The sanguine sunrise, with his meteor eyes,
And his burning plumes outspread,
Leaps on the back of my sailing rack,
When the morning-star shines dead;
As on the jag of a mountain crag,
Which an earthquake rocks and swings,
An eagle alit one moment may sit
In the light of its golden wings.
And when sunset may breathe, from the lit sea beneath,
Its ardours of rest and love,
And the crimson pall of eve may fall
From the depth of heaven above,
With wings folded I rest, on mine airy nest,
As still as a brooding dove.

That orbèd maiden, with white fire laden,
Whom mortals call the moon,
Glides glimmering o'er my fleece-like floor,
By the midnight breezes strewn;
And wherever the beat of her unseen feet,
Which only the angels hear,
May have broken the woof of my tent's thin roof,
The stars peep behind her and peer;
And I laugh to see them whirl and flee,
Like a swarm of golden bees,
When I widen the rent in my wind-built tent,
Till the calm rivers, lakes, and seas,
Like strips of the sky fallen through me on high,
Are each paved with the moon and these.

From cape to cape, with a bridge-like shape,
Over a torrent sea,
Sunbeam-proof, I hang like a roof,
The mountains its columns be.
The triumphal arch through which I march
With hurricane, fire, and snow,
When the powers of the air are chained to my chair,
Is the million-coloured bow;
The sphere-fire above its soft colours wove,
While the moist earth was laughing below.

I am the daughter of earth and water,
And the nursling of the sky;
I pass through the pores of the ocean and shores;
I change, but I cannot die:
For, after the rain, when, with never a stain,
The pavilion of heaven is bare,
And the winds and sunbeams, with their convex gleams,
Build up the blue dome of air,
I silently laugh at my own cenotaph,
And out of the caverns of rain,
Like a child from the womb, like a ghost from the tomb,
I arise and unbuild it again. SHELLEY.

CHOICE PASSAGES FROM EMINENT PREACHERS.

Composure of Mind necessary to Prayer.—PRAYER is the issue of a quiet mind, of untroubled thoughts; it is the daughter of charity, and the sister of meekness; and he that prays to God with an angry, that is, with a troubled and discomposed spirit, is like him that retires into a battle to meditate, and sets up his closet in the outquarters of an army. Anger is a perfect alienation of the mind from prayer; it causes the thoughts to be troubled and broken, so that there cannot be that attention which presents our prayers in a right line to God; and the good man who yields to such an infirmity must be content to lose his prayer; and he can recover it only when his anger is removed, and his spirit is becalmed, made even as the brow of Jesus, and smooth like the heart of God. For so have I seen a lark rising from his bed of grass, and soaring upwards singing as he rises, and hoping to get to heaven and climb above the clouds; but the poor bird was beaten back with the loud sighings of an eastern wind, and his motion made irregular and unconstant, descending more at every breath of the tempest than it could recover by the libration and frequent weighing of his wings; till the little creature was forced to sit down and pant, and stay till the storm was over; and then it made a prosperous flight, and did rise and sing as if it had learned music and motion from an angel, as he passed sometimes through the air about his ministries here below. JEREMY TAYLOR.

Man's Intellect before the Fall.—I confess it is difficult for us, who date our ignorance from our first being, and have been bred up with the same infirmities about us with which we were born, to raise our thoughts and imagination to those intellectual perfections that attend our nature in the time of innocence. This is as difficult for us, as it is for a peasant, bred up in the obscurities of a cottage, to fancy in his mind the unseen splendours of a court. But by rating positives by their privatives, and other arts of reason, by which discourse supplies the want of the reports of sense, we may collect the excellency of the understanding then by the glorious remainders of it now, and guess at the stateliness of the building by the magnificence of its ruins. All those arts, rarities, and inventions, which vulgar minds gaze at, the ingenious pursue, and all admire, are but the relics of an intellect defaced by sin and time. We admire it now, only as antiquaries do a piece of old coin, for the stamp it once bore, and not for those vanishing lineaments and disappearing draughts that remain upon it at present. And certainly that must needs have been very glorious, the decays of which are so admirable. He that is comely when old and decrepit, surely was very beautiful when he was young. An Aristotle was but the rubbish of an Adam, and Athens but the rudiments of Paradise. SOUTH.

On the threatened Invasion in 1803.—By a series of criminal enterprises, the liberties of Europe have been gradually extinguished; and we are the only people in the eastern hemisphere who are in possession of equal laws and a free constitution. But freedom, driven from every spot on the Continent, is pursued even here, and threatened with destruction. The inundation of lawless power, after covering the whole earth, threatens to follow us here; and we are most exactly, most critically, placed in the only aperture where it can be successfully repelled—in the Thermopylæ of the world. As far as the interests of freedom are concerned—

the most important by far of sublunary interests!—you, my countrymen, stand in the capacity of the federal representatives of the human race; for with you it is to determine (under God) in what condition the latest posterity shall be born. If liberty, after being extinguished on the Continent, is suffered to expire here, whence is it ever to emerge in the midst of that thick night that will invest it? It remains with you, then, to decide, whether that freedom, at whose voice the kingdoms of Europe awoke from the sleep of ages, to run a career of virtuous emulation in everything great and good;—the freedom which dispelled the mists of superstition, and invited the nations to behold their God, whose magic torch kindled the rays of genius, the enthusiasm of poetry, and the flame of eloquence;—the freedom which poured into our lap opulence and arts, and embellished life with innumerable institutions and improvements, till it became a theatre of wonders;—it is for you to decide, whether this freedom shall yet survive, or be covered with a funeral-pall, and wrapped in eternal gloom. It is not necessary to await your determination. In the solicitude you feel to approve yourselves worthy of such a trust, every thought of what is afflicting in warfare, every apprehension of danger must vanish, and you are impatient to mingle in the battle of the civilized world. Go then, ye defenders of your country, accompanied with every auspicious omen; advance with alacrity into the field, where God himself musters the host to war. Religion is too much interested in your success not to lend you her aid; she will shed over this enterprise her selectest influence. While you are engaged in the field, many will repair to the closet, many to the sanctuary; the faithful of every name will employ that prayer which has power with God; the feeble hands, which are unequal to any other weapon, will grasp the sword of the Spirit; and from myriads of humble contrite hearts, the voice of intercession, supplication, and weeping, will mingle, in its ascent to heaven, with the shouts of battle and the shock of arms. And it is next to impossible for victory not to crown your exertions; for the extent of your resources, under God, is equal to the justice of your cause. But should Providence determine otherwise—should you fall in this struggle, should the nation fall—you will have the satisfaction (the purest allotted to man!) of having performed your part; your names will be enrolled with the most illustrious dead; while posterity to the end of time, as often as they revolve the events of this period—and they will incessantly revolve them—will turn to you a reverential eye, while they mourn over the freedom which is entombed in your sepulchre. I cannot but imagine that the virtuous heroes, legislators, and patriots of every age and country, are bending from their elevated seats to witness this contest, as if they were incapable, till it be brought to a favourable issue, of enjoying their eternal repose. Enjoy that repose, illustrious immortals! Your mantle fell when you ascended; and thousands, inflamed with your spirit, and impatient to tread in your steps, are ready to swear by Him that sitteth upon the throne, and liveth for ever and ever, they will protect freedom in her last asylum, and never desert that cause which you sustained by your labours, and cemented with your blood. And Thou, sole Ruler among the children of men, to whom the shields of the earth belong, gird on Thy sword, Thou Most Mighty! Go forth with our hosts to the battle! And while led by Thine hand, and fighting under Thy banners, open Thou their eyes to behold in every valley and on every plain, what the prophet beheld by the same illumination—chariots of fire, and horses of fire!

ROBERT HALL.

The Negro Race.—We are told that the negro is so degenerate a variety of the human species, as to defy all cultivation of mind. Our minute philosophers tell us so—men who take the gauge of intellectual capacity from the contour of the head and the countenance; who measure mind by the rule and compasses, and estimate capacity for knowledge and salvation by a scale of inches, and the acuteness of angles. . . . And yet, will it be believed, that this contemned race can, as to intellect and genius, exhibit a brighter ancestry than our own; that they are the offshoots—wild and untrained, it is true, but still the offshoots—of a stem which was once proudly luxuriant in the fruits of learning and taste; whilst that from which the Goths, their calumniators, have sprung, remained hard, and knotted, and barren? For is Africa without her heraldry of science and of fame? The only probable account which can be given of the negro tribes is, that—as Africa was peopled, through Egypt, by three of the descendants of Ham—they are the offspring of Cush, Misraim, and Put. They found Egypt a morass, and converted it into the most fertile country of the world: they reared its pyramids, invented its hieroglyphics, gave letters to Greece and Rome, and, through them, to us. The everlasting architecture of Africa still exists, the wonder of the world, though in ruins. And for negro physiognomy, as though that should shut out the light of intellect, go to your national museum—contemplate the features of the colossal head of Memnon, and the statues of the divinities on which the ancient Africans impressed their own forms—and there see, in close resemblance to the negro feature, the mould of those countenances which once beheld, as the creations of their own immortal genius, the noblest and most stupendous monuments of human skill, and taste, and grandeur. In the imperishable porphyry and granite is the unfounded and pitiful slander publicly, and before all the world, refuted. There we see the negro under cultivation. If he now presents a different aspect, cultivation is wanting. That solves the whole case. RICHARD WATSON.

Man an Object of Heavenly Sympathy.—When one of a numerous household droops under the power of disease, is not that the one who, in a manner, monopolizes the care of his family? When the sighing of the midnight storm sends a dismal foreboding into the mother's heart, to whom of all her offspring are her thoughts and her anxieties then wandering? Is it not to her sailor-boy, whom her fancy has placed amid the rude and angry surges of the ocean? Does not this, the hour of his apprehended danger, concentrate upon him the whole force of her every sensibility and her every prayer? We sometimes hear of a shipwrecked passenger thrown upon a barbarous shore; and seized upon by its prowling inhabitants; and hurried away through the tracks of an unknown wilderness; and sold into captivity; and loaded with the fetters of irrecoverable bondage:—Oh tell us, when the fame of all this disaster reaches his family, who is the member of it to whom is directed the full tide of its griefs and of its sympathies?—tell us if you can assign a limit to the pains, and the exertions, and the surrenders which afflicted parents and weeping sisters would make to seek and to save him? Now conceive, as we are warranted to do, the principle of all these earthly exhibitions to be in full operation around the throne of God. Conceive the universe to be one secure and rejoicing family, and that this alienated world is the only strayed, or only captive member belonging to it; and you shall cease to wonder, that angels should so often have sped their commissioned way on the errand of our recovery; or that the Son of God should have bowed himself down to the burden of our mysterious atonement; or that the Spirit of God should now, by the busy variety of His influences, be carrying forward that dispensation of grace which is to make us meet for admittance into the mansions of the celestial. Only think of love as the reigning principle there; of love, as sending forth its energies and aspirations to the quarter where its object is most in danger of being for ever lost to it; of love, as called forth by this single circumstance to its uttermost exertion and most exquisite tenderness; and then shall you no longer resist, by your incredulity, the gospel message, though it tells you, that throughout the whole of this world's history, long in our eyes, but only a little month in the high periods of immortality, the vigilance and the earnestness of heaven have been expended on the recovery of its guilty population.

CHALMERS.

STRIKES.

Do workpeople act wisely when they combine together, and refuse to work for less than a certain rate of wages?

We will suppose that all the cotton-factory workers in Manchester combine together to demand higher wages. They make their demand, and give the masters time to consider it. The masters know that, if they have to pay more for labour, they must charge more for their goods. They know, too, that in Stockport, Preston, and other towns, there are masters who make the same kind of goods as themselves; and persuaded that their goods would become unsaleable, if they charged more than those other masters, they resolve not to raise the price, but to resist the demand of their workmen.

The men, on hearing this, and still believing that their masters *could* give them higher wages if they *would*, refuse to work—that is, they *strike*. What is the result?

During the first week or two, the masters, perhaps, close their factories, hoping that the men will think better of the matter and return to their work. Disappointed in this expectation, they next send to the neighbouring towns for other cotton-workers; and if they succeed in obtaining a sufficient number, there is virtually an end of the strike; for the old hands, finding that their places are being rapidly filled up by others, will be glad to return to their work at the wages offered by the masters, rather than be thrown out altogether; so that, in this case, the strike wholly fails of its object.

But trade may be so good in other places that the masters cannot get men from them; in that case, what will happen? If the masters find that they can afford to give somewhat higher wages than before, without raising the price of their goods, they may offer the hands on strike a small advance of wages, rather than incur the loss of capital and of customers which would ensue from keeping their factories closed. But if they find (which is much more likely) that they cannot increase wages without having to sell their goods at a loss, they will still resist the demand of the men. Thus the strike will continue. The men will hold out, in the belief that the masters will at last yield rather than keep the factories closed; and the masters will hold out, in the hope that the men will soon tire of earning nothing, and go to work again as before. The issue of such a struggle will of course depend upon the comparative strength of the two parties; that is, the party which is able to hold out the longer will eventually win the day. And as the masters are always in this respect the stronger party, the issue will be, that the men must at last give in, no matter whether they are right or wrong in demanding higher wages.

But it may, perhaps, be thought that the reason why a strike like this fails to get workmen what they want is, that it is only a *partial* strike—a strike in only one or two towns at the same time. If a *universal* strike were to take place—if *all* the workpeople of the same trade, throughout the country, were to strike *together*—might not the workpeople gain their object?

Now, no doubt, if a really universal strike were made in any trade, the masters would be obliged, in the first instance, to yield; for they could not afford to give up their business and lose their capital. At the outset, then, the men would gain their object. But would the higher wages, thus obtained, *last?* They would not. The higher wages would cause the cost of production to be greater; and the masters, to compensate themselves for that greater cost, would have to charge more for their goods. This rise in price would cause people to buy less of the commodity than before; or, in other words, the demand for it would decrease. When the masters found that they were selling less, they would *produce* less. And in order to decrease the supply, they would either put *all* their hands on *short time*—that is, reduce the days or hours of work—or *dismiss some* of their hands. Now, if the masters were to put their hands on *short time*, it is plain that these hands would no longer earn a full week's pay; so that their actual wages, though nominally higher, might be really lower than before the strike. Thus, suppose they obtained by the strike a rise of wages from twenty to twenty-one shillings a-week, still, with work for only five days a-week, they would earn but seventeen shillings and sixpence, and thereby lose half-a-crown a-week. At a higher rate of wages than before, their earnings would really be less; and as the short-time working would be sure to continue as long as the demand for goods remained slack, the workpeople would find that the strike, though a gain to them at first, was a loss in the end. The masters, however, when the demand for their goods fell off, would be more likely to dismiss some of their hands than to keep them all on short time. What would then be the consequence? Would those who were kept on continue to gain by the strike? They would not. The dismissed hands, finding that they could get no one to employ them—as *all* masters would be obliged to discharge some of their hands—would be sure to offer to work at less than the employed hands were getting. This would cause the latter either to accept lower wages, or to be dismissed to make room for those willing to do so. In such a state of things, when all masters were dismissing hands, the competition for employment would be so great as to bring wages down *lower* than they were before the strike; at which point they would remain till the demand had slowly increased to what it was before. And so, after suffering a great deal while out of work, all the workpeople would find themselves *worse off* than before the strike.

Even if we were to suppose the demand for the goods *to remain the same*, after the rise in price caused by the increase in wages, the workpeople would not long continue to gain. The high wages received by them would induce many to leave other employments not so well paid, and to follow the better paid trade. An increase would thus take place in the supply of hands, and with this increased supply of labour, its price would decrease—or, in other words, wages would fall.

From what has been said we learn that a *partial* strike must fail, either because workpeople not on strike will take the places of those who are, or because the masters can hold out much longer than their hands. And we also learn that a *universal* strike must fail, because, though the workpeople may gain for a time, wages will be afterwards reduced below what they were before the strike, either by the workpeople being put on short time, or by a part of them being dismissed, or by the supply of labour increasing.—TEMPLAR.

EVILS OF STRIKES.

IT would be too much to affirm that workpeople should never resort to a strike. Whenever the painful suspicion arises among a body of operatives that the master is taking advantage of them by paying them less than the just value of their labour, there can obviously be no cordial co-operation between master and men, until some test has been applied to ascertain the true value of labour; and what more decisive test can there be than a strike? The master replies to the demand for higher wages, "I cannot afford it." How are the men to know that this is really the fact? So long as they work at the old wages, the problem must remain unsolved; and if, therefore, after due inquiry, they become convinced that the master is really underrating their labour, or, in other words, that the labour market of their trade is not full, they may fitly enough resolve to try the issue by refusing to work unless at advanced wages. If the master has been paying them at a fair rate, though at a lower one than they desire, other workmen will easily be found to supply their place; but if, on the other hand, he has been underpaying them, other workmen will not be forthcoming, and they will obtain the rise of wages they demand. So that in either case the question as to the true value of their labour will receive, at the end of the strike, a decisive answer.

But a strike, though thus a decisive experiment, is also an expensive one; and, therefore, it behoves workpeople, before resorting to it, to take due account of the evils which they may thereby bring on themselves and others, should their estimate of the market value of their labour turn out to be a mistaken one.

When workmen are out on strike, they must live, though they are earning no wages,—they must have food, clothing, fuel, and shelter. To get these, they must spend their previous savings, if they have any; or they must sell their furniture; or, which is often worse, they must run into debt, and so have in the end to pay for credit in addition to the price of the articles they consume. A long-continued strike must thus reduce the strikers to destitution; and even a short one must subject them to severe straits: while they may also incur the risk of being unable to find employment and wages when they become willing to resume work, owing to their places having been filled in the meantime by other workmen. It will require a long period of high wages, after the strike is over, to enable a workingman to regain his savings, replace his furniture, pay his debts, and resume the social position he occupied before the strike.

Besides exposing themselves to these sore privations, operatives who go out on strike bring similar hardships on other workmen who, though opposed to the strike, are also thrown out of work by it. Every large work gives employment not only to a number of skilled artisans, but also to a number of labourers, carters, etc.; and whenever the former leave off working, the latter, however unwillingly, must likewise go idle. The shopkeepers too, and other tradesmen with whom the strikers have been in the habit of dealing, must suffer loss by the falling off in the demand for their goods, and by the bad debts which arise from the poverty of their customers. And the masters also suffer; for when no work is done, there can of course be no *profit* to the master, and no *interest* on the capital he has invested in his business. Nor is the loss of profit and interest all. While the men are out on strike, the master cannot execute the orders of his customers, nor fulfil the contracts into which he may have entered. He must, therefore, disappoint his customers, and even in some instances break faith with them; of which the consequence will be, that some of them will give up dealing with him, and go to other producers for what they want. His business will thus fall off,—nay, he may altogether lose it.

The three following instances may serve at once to illustrate and to verify the preceding remarks.—In the summer of 1836, the cotton-spinners of Glasgow memorialized their masters for a rise in wages, trade being brisk and profits large; and as there was a competition among the manufacturers for workmen, the advance was agreed to. But when the commercial crisis of 1837 came, and prices fell so much that cotton-yarn would not sell with a profit at the advanced rate of wages, the masters proposed that wages should be reduced to the former rate of from 26s. to 36s.

a-week. The workmen, refusing to agree to the reduction, struck work in a body on the 8th of April, and continued on strike for seventeen weeks, when they unanimously agreed to return to their work on terms lower than those first offered by the masters, after having endured extreme hardships themselves and caused wide-spread misery among others. The number of spinners in Glasgow in 1837 was nearly 900,—each of them giving employment to a certain number of young women, about seven for each spinner; so that about 6000 females were deprived of the means of livelihood through the folly and perverseness of the strikers. It was calculated that the total loss during the strike—including the loss to spinners, carders, carters, importers of cotton, tradesmen, and masters—amounted to no less a sum than £273,000.—On the 5th November 1836, the cotton-spinners of Preston struck, and ceased working for thirteen weeks. As many as 8500 persons were thrown idle. Of this number only 660 (who were spinners) voluntarily left their work; the rest had to leave it, because there was no employment for them in the absence of the spinners. It was estimated that the loss of wages by persons willing to continue at work was £60,361; that the loss to the 660 spinners in wages during the turn-out was £9652; and that the total loss to the town and trade of Preston was £107,196. The town was crowded with beggars; the workhouses were besieged by applicants for relief; three persons were known to have perished of starvation; and, after a contest of months, work was resumed on the terms offered by the masters; while one-third of the spinners were obliged to leave the town, their places being occupied by new comers.—In 1837, the whole colliers in Lanarkshire, 2000 in number, struck work, owing to a proposal to reduce their wages from 35s. to 30s. a-week: they remained unemployed for six months; and at the end of that period they were glad to resume work on the terms which they had rejected. The loss inflicted on the inhabitants of Glasgow and its neighbourhood by the increase in the price of coals during the strike was £487,000; the loss sustained by the colliers themselves from stoppage of wages was £78,000; the loss occasioned to other labourers by the strike, although most of them were opposed to it, was £111,000,—the total loss was £676,000.

Another evil of strikes is the great and permanent injury which they often inflict on particular seats of industry. When it is known that the workmen of a particular town are out on strike or are prone to strike, people cease to send orders for goods to that town; and so the town loses the trade or business on which, perhaps, its inhabitants mainly depend. This has been the case with many towns. At one time Dublin possessed a great many shipwrights, who got good pay and had plenty of work: but these men, by always striking for higher wages when their masters were busy, put it beyond the power of the masters to execute the orders of customers in proper time. What was the consequence? Orders for ships ceased to be sent to Dublin, and the shipbuilding trade of that city went elsewhere; so that these foolish shipwrights, so far from gaining anything by their strikes, lost all,—they killed the goose that laid their golden eggs. In the same way, much of the lace-trade was driven from Nottingham, and much of the silk-trade from Macclesfield. Nor is it particular places only that have thus suffered by strikes: the whole country has suffered. English machine-makers have lost many good customers, who have transferred their orders to the workshops of France and Belgium; whole branches of the cotton-manufacture have been driven out of England into America and Switzerland; and not a few capitalists, from being unable to depend on their workmen, have removed their establishments to the Continent.

But, perhaps, the worst evil of strikes is the cruelty of the men on strike towards those who are willing to work for the wages offered by the masters. Whenever a strike seems likely to last beyond a few weeks, the employers send to other places for men, offering them the same wages as they offer to the men on strike. But when the new hands agree to the terms offered, and go to work, they generally find themselves interfered with by the old hands, who resort to vituperation, menace, and even personal violence, in order to prevent them from working. It need not be said that such conduct is utterly disgraceful. The new hands have just as good a right to *take* the wages offered by the masters, as the old hands have to *refuse* them. Every one has a perfect right to sell his labour for what he pleases; and to resort to force or intimidation in order to deter a man from freely exercising that right, is the height of injustice, cowardice, and oppression. *Compiled.*

ARETHUSA.

ARETHUSA arose from her couch of snows
In the Acroceraunian mountains—
From cloud and from crag, with many a jag,
Shepherding her bright fountains.
She leapt down the rocks, with her rainbow locks
Streaming among the streams;—
Her steps paved with green the downward ravine
Which slopes to the western gleams:
And gliding and springing she went, ever singing
In murmurs as soft as sleep;
The Earth seemed to love her, and Heaven smiled above her
As she lingered toward the deep.

Then Alpheus bold on his glacier cold,
With his trident the mountains strook;
And opened a chasm in the rocks;—with the spasm
All Erymanthus shook.
And the black south wind it concealed behind
The urns of the silent snow,
And earthquake and thunder did rend in sunder
The bars of the springs below:
The beard and the hair of the River-God were
Seen through the torrent's sweep,
As he followed the light of the fleet nymph's flight
To the brink of the Dorian steep.

"Oh, save me! oh, guide me! and bid the deep hide me!
For he grasps me now by the hair!"
The loud Ocean heard, to its blue depth stirred,
And divided at her prayer;
And under the water the Earth's white daughter
Fled like a sunny beam.

Behind her descended her billows, unblended
With the brackish Dorian stream:
Like a gloomy stain on the emerald main,
Alpheus rushed behind,—
As an eagle pursuing a dove to its ruin,
Down the streams of the cloudy wind.

Under the bowers where the Ocean Powers
Sit on their pearled thrones;
Through the coral woods of the weltering floods,
Over heaps of unvalued stones;
Through the dim beams which, amid the streams,
Weave a network of coloured light,
And under the caves, where the shadowy waves
Are as green as the forest's night,—
Outspeeding the shark and the sunfish dark,
Under the ocean foam,
And up through the rifts of the mountain clifts,—
They passed to their Dorian home.

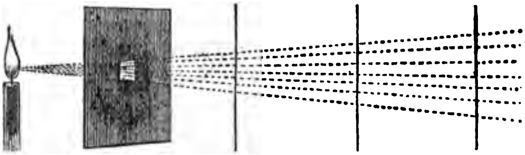
And now from their fountains in Enna's mountains,
Down one vale where the morning basks,
Like friends once parted, grown single-hearted,
They ply their watery tasks.
At sunrise they leap from their cradles steep
In the cave of the shelving hill;
At noontide they flow through the woods below
And the meadows of asphodel;
And at night they sleep in the rocking deep,
Beneath the Ortygian shore,—
Like spirits that lie in the azure sky,
Where they love, but live no more. SHELLEY.

GENERAL PROPERTIES OF LIGHT.

LIGHT is one of the most beautiful and useful phenomena in the world. It was long a subject of controversy among philosophers whether light consisted of material particles thrown off from luminous bodies, or was the result of undulations or vibrations propagated from the luminous body; but the latter theory is the one now generally held. The general properties of light, however, have long been determined, and are not difficult to apprehend.

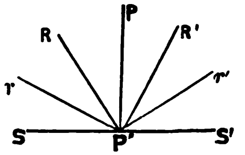
Light proceeds from every part of a luminous body in straight lines. This may be shown by causing light to pass through small holes into a dark room filled with smoke or dust. It is proved also by the fact, that bodies cannot be seen through bent tubes; and it may be inferred from the form of the shadows of bodies. Some suppose that transparency is owing to the rectilineal arrangement of the pores of bodies, which enables them to act like straight tubes for the free passage of light; and that opacity is caused by an opposite arrangement, in consequence of which rays are intercepted, as if by bent tubes.

Light diffuses itself more and more as the distance from its source increases. Thus, if a candle be placed behind an opaque screen pierced with small holes over one square inch of its surface, and if a sheet of paper be placed close to the screen, we shall see upon the paper specks of light marking out a square inch. If the sheet of paper be removed further from the screen, the illuminated space will increase; and more careful experiments will show that the increase is as the squares of the distances, and indicates a diverging pyramid of rays. But while the space illuminated increases, the intensity of illumination diminishes, and that, too, in proportion to the square of the distance from its source. At two feet from a candle, a person has only the fourth part of the light which he would have at one foot, at three feet the ninth part, at four feet the sixteenth part, and so on.



Light moves with prodigious velocity. It has been ascertained from various astronomical phenomena—especially from the fact that eclipses and immersions of the satellites of Jupiter become visible fifteen minutes sooner when the planet is at its least, than when it is at its greatest, distance from us—that light travels at the rate of 186,000 miles in a second of time. The light from the sun reaches the earth in seven minutes and a half—though the distance is such that a cannon-ball, fired with the greatest force from the sun, and continuing its velocity unabated, would require more than seventeen years to traverse the distance.

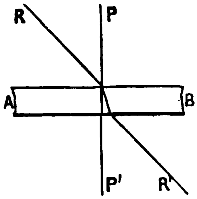
If a source of light, such as a candle, is brought into a dark room, all the objects in the room are more or less illuminated. Here we have not only the transmission of light in radiant lines or rays from the source of illumination, but also the turning back of these rays, or their *reflection* from the objects illuminated. It is owing to this reflection of light from their surfaces that bodies which are not themselves luminous become visible to us; and the law which it follows is extremely simple. If the light falls at right angles on any reflecting surface, it returns again at right angles, or in the same line towards the luminous body; but if the rays fall at an angle with the perpendicular of the surface—or, in other words, on one side of that perpendicular—they are reflected at the same angle with it on the side directly opposite.



S S′, reflecting surface.
P P′, perpendicular of reflecting surface.
R *r*, incident rays.
R′ *r′*, reflected rays.

This law, expressed in scientific language, is that the angle of reflection is equal to the angle of incidence; and it at once explains such familiar phenomena as the following. If I stand before a mirror, I see my image reflected back to me. If I stand a little to the side, I cannot see myself; but a person who stands just as far on the other side of it can see my image in the glass, and I see his. If I place a candle a little to one side, I must go as far on the other to see its image in the glass.

It has been already stated that light passes in straight lines. But this is true only so long as the medium through which it travels preserves the same density and the same chemical nature. When that ceases to be the case, the ray of light is bent from its course into a new one, or is, in optical language, *refracted.* Thus, the end of a stick, when put in water appears bent, owing to the refraction which the light suffers in passing from air, a rare medium, into water, a dense medium. If a shilling be put in a basin, and the eye placed so as just to see the edge of the shilling, then if water be poured into the basin, the shilling will be seen most distinctly; for, when no water is in the basin, the rays of light from the shilling, proceeding in straight lines, are prevented from reaching the eye by the side of the basin; but when water is poured in they suffer a refraction in emerging from water a dense medium, into air a rare medium, and consequently proceed to the eye.

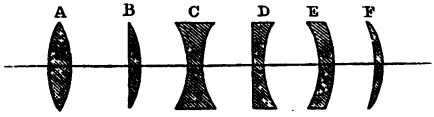


A B, a piece of thick plate glass.

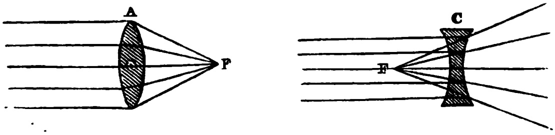
R R′, a ray of light which first proceeds in a straight line through the air, then becomes refracted by the glass, and resumes its original direction on passing from the glass again into air.

The general law of refraction is thus expressed:—When the ray passes from a rare to a denser medium, it is refracted *towards* a line perpendicular to the surface of the latter; and conversely, when it leaves a dense medium for a rarer one, it is refracted *from* a line perpendicular to the surface of the denser substance. In the former case the angle of incidence is greater than the angle of refraction; in the latter, it is less.

Different bodies possess different refractive powers, and generally the densest substances refract most. Combustible bodies, however, usually possess greater refractive power than their density would indicate; and from observation of this fact, Sir Isaac Newton predicted the combustible nature of the diamond long before anything was known respecting its chemical nature. It is owing to the increasing density of the atmosphere as it approaches the earth, that the sun's rays are so refracted as to cause the sun and moon to appear larger at the horizon than at the zenith. To the same cause we owe the twilight of our climate; and in the increased refractive power which moisture imparts to the atmosphere, we have an explanation of the fact that distant objects seem nearer and loom more largely in moist than in dry weather. It is in consequence also of the property of refraction that lenses and other optical instruments are available to the purposes of man. A *lens* is usually made of polished glass, and has different names according to its shape; as prism, double-convex lens, plano-convex lens, meniscus, etc.—The two kinds most commonly in use are the convex and the concave. The glasses of spectacles for old people, or burning-glasses, are convex lenses; an eye-glass for short-sighted people is a concave lens. A convex lens collects the rays of light into a point called a focus, which, in a single convex lens, is the centre of the sphere of which the lens is a part. A piece of paper may be lighted by such a lens. A voyager to the North Pole is said to have made a large burning-glass of ice, which set fire to wood, to the great astonishment of the sailors.



A the double convex, B the plano-convex, C the double concave, D the plano-concave, E the concavo-convex, and F the meniscus. The first, A (the common magnifying glass), collects the rays that pass through it to a common point or focus F beyond.

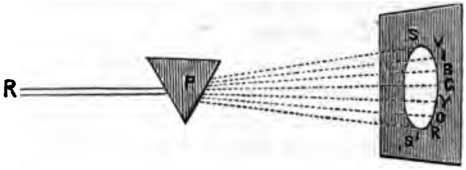


In C, on the other hand, the rays are made to diverge, or spread out wider.

Compiled.

COMPOSITION OF LIGHT.

LIGHT is of a compound nature. If a ray of sunlight be admitted into a dark room by a small hole in a shutter, or otherwise, and then made to fall upon a triangular piece of glass—that is a prism—so that it may pass through the prism, it will not only be refracted from its straight course, but will be decomposed into seven coloured rays, which may be received upon a screen placed behind the prism—forming there a distorted image of the sun. The image on the screen is called the *solar* or *prismatic spectrum;* and the seven colours composing it are—*red*, *orange*, *yellow*, *green*, *blue*, *indigo*, and *violet*.



R, ray of sunlight.—P, prism.—S S′, spectrum.
V, I, B, G, Y, O, R, the seven prismatic colours.

This is the celebrated experiment of Sir Isaac Newton; and he drew from it the inference that white light is composed of seven primitive colours, the rays of which are differently refrangible by the same medium, and hence capable of being thus separated. He found that the violet ray is most refrangible, the red ray least; and he also found that the illuminating powers of the rays are very different—the light being intensest in the yellow ray, and gradually diminishing towards either end of the spectrum. The colours of natural objects, according to Sir Isaac Newton, result from the power which the surfaces of the bodies possess of absorbing some of the coloured rays, while they reflect the rest. Thus an object appears red because it absorbs all but the red ray. White is occasioned by the body being so constructed as to reflect all the seven colours. Black is occasioned by their absorption, and is, strictly speaking, the absence of all colour. Hence, since light and heat are inseparably connected, white is the coolest dress in summer, and black the warmest. Hence, too, a person dressed in white is seen at some distance in the street at night, while a person in a dark dress is not. Men who go to shoot rabbits at night, rub the barrels of their guns with chalk in order that they may be able to take aim.

The most striking example of the decomposition of light is presented by the rainbow. This beautiful phenomenon is never seen but in the time of rain or near it, and when the sun shines. When a ray from the sun falls upon a drop of rain in a cloud, if it enter the upper part of the drop, it will, by refraction, be thrown upon the inner surface of the back part of the drop; thence it will be reflected to the lower part of the drop, at which place, undergoing a second refraction, it will be bent towards the earth; and thus rays of the sun, after one reflection and two refractions, may come to the eye of a spectator, whose back is towards the sun, and his face towards the drop. When rays emerge from the drop after one reflection and two refractions, those which are most refrangible will, at their emersion, make angles with the incident rays different from those which are least refrangible; by which means the rays that produce the sensations of different colours will be separated from one another. Hence it may easily be perceived that some of the fallen globules may be in that position which will cause the rays that produce a red colour to fall upon the eye; others next to them below will send forth orange-making rays,—the drops next to them will cast the yellow-making rays,—and those successively in order below them will refract the blue, indigo, and violet-making rays to the eye. Thus, in a certain space in the cloud, all the colours will appear; and since, under the same angles, the same phenomena will be produced, therefore an arch of this various-coloured light must necessarily be produced in the clouds.

The rainbow, however, though the most brilliant, is very far from being the only example in nature of the decomposition of white into coloured light. All transparent bodies have the power of decomposing the light which falls upon them. So have all crystalline bodies, and all bodies with surfaces of a filmy structure. The boy blows his soap bubble, and is delighted to witness, as it floats in the air, the beautiful play of colours on its surface. The salts with which beef is cured give all the colours of the spectrum to the fibres when cut across. The very scum of mantling pools paints rainbows for us. And think of the varying tints of the pigeon's neck, the peacock's tail, the lizard's skin, the humming-bird's feathers! The gems of the mine, the flowers of the field, and the birds of the air, all bear witness to the power which the Great Author of nature has given to his creatures to appear in the decomposed, varied, and contrasted glories of the solar beams. *Compiled.*

CHEMICAL POWER OF LIGHT.

It has long been known that the sunbeam radiates heat as well as light, and that the heating power of the different coloured spaces in the spectrum increases from the violet to the red extremity,—the chief heating rays being at and near the red. But it is only in recent times that the chemistry of the sunbeam has been investigated, and the fact established that its illuminating and calorific virtues are accompanied by a power of effecting chemical changes. In proof of its power to effect chemical combination, it may suffice to mention, that chlorine and hydrogen combine at common temperatures only under the influence of light; and, in proof of its decomposing action, we need only refer to the well-known fact that some salts of silver, when exposed to the sunshine, change colour, and become nearly black.

Strange as it may appear, it is not always the luminous part of the ray which effects these chemical changes. They are chiefly produced by certain invisible rays, which accompany the others, and which are found most abundantly beyond the violet part of the spectrum. It is there that certain chemical effects are most marked. In other words, it is at the portion of the spectrum where the illuminating and heating powers are feeblest, that the chemical power is strongest. Now, it is this remarkable fact—the fact that some salts of silver are less readily decomposed by the luminous and heating rays than by certain rays that extend beyond the ordinary visible spectrum—which has led chemists to conclude that there exists in the sunbeam, in addition to light and heat, a principle or power which produces chemical effects. This principle has received the provisional name of *actinism*—from the Greek *actis*, a ray—and light is now held to consist of three compound parts, or, at least, to exhibit three distinct phenomena—*light*, *heat*, and *actinism*. Not that the luminous and calorific rays are wholly destitute of chemical power. On the contrary, they all act to some extent upon salts of silver. But the actinism is most energetic at the violet extremity.

Upon the chemical changes produced by light is based the art of *Photography*. The possibility of producing what are now called photographic pictures was demonstrated many years ago. It was ascertained by experiment that impressions of leaves, feathers, insects' wings, and other small objects could be obtained on paper which had been rendered sensitive to the sun's rays by a coating of nitrate of silver. But it was not then known by what means the action of light could be arrested, and a picture, changing as quickly as thought, be fixed at any desired moment so as to make it permanent. It was not till 1839 that this important discovery was made, or, at any rate, made public; and then, singular to say, it was announced simultaneously by M. Daguerre in France, and by Mr Fox Talbot in this country. It is to the genius and research of these two gentlemen, followed by the investigations and experiments of numerous others, that we are indebted for those sun-pictures of men, buildings, and landscapes now so common.

A *camera obscura* is an essential part of the photographic apparatus. It consists of a portable box, with a lens at one end, and suitable arrangements for adjusting the lens to the focal distance. In this box the substance which is to be acted on by the sunlight is placed—whatever it may be, a metallic plate, or paper, or glass—after it has been previously made sensitive to light by a coating of iodide of silver, or other chemical preparation. The person whose portrait is to be taken is placed in front of the darkened camera, in such a situation that the light reflected from him shall fall upon the surface of the prepared plate or paper;

the screen or curtain is then removed from the lens, and in a very few seconds the radiations from his person will, by their chemical action, produce an image or picture of him on the plate or paper. The picture thus obtained is at first invisible, and requires to be developed or exalted by the application of some chemical compound; and as it is also *negative*—the lights and shadows being reversed—an additional process is necessary to make it *positive*. But after these changes have been effected — and the lights and shadows fixed or rendered permanent by employing another chemical material—we obtain a portrait so exact and complete, that it will bear the most minute examination with a magnifying glass, the smallest details being depicted with perfect fidelity.

The great and beneficial influence which the sunbeam, by means of its three agencies of light, heat, and actinism, exerts on the phenomena of nature must be manifest to every observer. Vegetable organization is specially dependent on the influence of light. The *etiolation* of celery and sea-kale is familiar instances of the complete check which is put to the formation of colouring matter when light is obstructed; and in darkness every vegetable form passes rapidly into an unhealthy state. The germination of the seed is due to the chemical power of the sunbeam; the growth of the plant and the formation of wood to the luminous rays; and the process of flowering and the perfection of the fruit to the heat-rays. "Can you tell me what power is driving that train?" said George Stephenson to Dr Buckland, as, standing on the terrace at Drayton Manor, they observed a railway-train passing, and throwing behind it a long line of white steam. "Well," said the geologist, "I suppose it is one of your big engines."—"But what drives the engine?"—"Oh, very likely a canny Newcastle driver."—"What do you say to the light of the sun?" said Stephenson.—"How can that be?" asked the Doctor.—"It is nothing else," the engineer replied; "it is light absorbed thousands of years ago by plants during their growth, and bottled up in the carbon into which they were subsequently condensed; and now, after being buried in the earth for long ages in fields of coal, that latent light is again brought forth, and made to work in the locomotive for great human purposes." *Compiled.*

THE BUILDING OF THE SHIP.

"Build me straight, O worthy Master!
  Staunch and strong, a goodly vessel,
That shall laugh at all disaster,
  And with wave and whirlwind wrestle!"
The merchant's word
Delighted the Master heard;
For his heart was in his work, and the heart
Giveth grace to every art:
  And with a voice that was full of glee
He answered, "Erelong we will launch
A vessel as goodly, and strong, and staunch,
  As ever weathered a wintry sea!"

And first, with nicest skill and art,
Perfect and finished in every part,
  A little model the Master wrought,
Which should be to the larger plan
What the child is to the man,
Its counterpart in miniature;
That with a hand more swift and sure
  The greater labour might be brought
  To answer to the inward thought.
The model showed a gallant craft;
  Broad in the beam—that the stress of the blast,
  Pressing down upon sail and mast,
    Might not the sharp bows overwhelm;
Broad in the beam, but sloping aft
  With graceful curve and slow degrees,
    That she might be docile to the helm,
  And that the currents of parted seas,
Closing behind with mighty force,
Might aid and not impede her course.

Covering many a rood of ground,
Lay the timber piled around;
  Timber of chestnut, and elm, and oak,

And, scattered here and there, with these,
The knarred and crooked cedar knees;
Brought from regions far away,
From Pascagoula's sunny bay,
  And the banks of the roaring Roanoke!
Ah! what a wondrous thing it is
  To note how many wheels of toil
One thought, one word, can set in motion!
There's not a ship that sails the ocean,
  But every climate, every soil,
Must bring its tribute great or small,
And help to build the wooden wall!

With the next rising of the sun
Was the noble task begun;
And soon throughout the shipyard's bounds
Were heard the intermingled sounds
Of axes, and of mallets, plied
With vigorous arms on every side;
Plied so deftly and so well,
That, ere the shadows of evening fell,
  The keel of oak for a noble ship,
Scarfed and bolted, straight and strong,
Was lying ready, and stretched along
  The blocks, well placed upon the slip.

Day by day the vessel grew,
With timbers fashioned strong and true,
  Stemson and keelson and sternson knee,
  Till framed with perfect symmetry,
A skeleton ship rose up to view!
And around the bows and along the side
The heavy hammers and mallets plied,
Till after many a week, at length,
Wonderful for form and strength,
Sublime in its enormous bulk,
Loomed aloft the shadowy hulk!

With oaken brace and copper band
Lay the rudder on the sand,
That, like a thought, should have control
Over the movement of the whole;
And near it the anchor, whose giant hand
Would reach down and grapple the land,

And immovable and fast
Hold the great ship against the bellowing blast!
And at the bows an image stood,
By a cunning artist carved in wood,
With robes of white, that far behind
Seemed to be fluttering in the wind.
It was not shaped in a classic mould—
Not like a Nymph or Goddess of old,
Or Naiad rising from the water—
But modelled from the Master's daughter!
On many a dreary and misty night,
'T will be seen by the rays of the signal light,
Speeding along through the rain and the dark,
Like a ghost in its snow-white sark!

Behold at last
Each tall and tapering mast
Is swung into its place;
Shrouds and stays
Holding it firm and fast!
  Long ago,
In the forests of Maine,
When upon mountain and plain
  Lay the snow,
They fell,—those lordly pines!
  'Mid shouts and cheers
  The jaded steers,
Panting beneath the goad,
Dragged down the weary, winding road
  Those captive kings so straight and tall,
To be shorn of their streaming hair,
And naked and bare
To feel the stress and the strain
Of the wind and the reeling main,
  Whose roar
  May remind them for evermore
Of their native forests they shall not see again.

All is finished! and to-day
  The gallant vessel shall be launched!—
  With fleecy clouds the sky is blanched,
And o'er the bay,
  Slowly, in all its splendours dight,
  The great sun rises to behold the sight.

The ocean old,
Strong as youth, and as uncontrolled,
Paces restless to and fro,
Up and down the sands of gold:
His beating heart is not at rest;
And far and wide,
With ceaseless flow,
His beard of snow
Heaves with the heaving of his breast.
He waits impatient for his bride:
And there she stands,
With her foot upon the sands,
Decked with flags and streamers gay,
In honour of her marriage-day!

Then the Master, with a gesture of command,
Waves his hand;
And at the word,
Loud and sudden there is heard,
All around her and below,
The sound of hammers, blow on blow,
Knocking away the shores and spurs.
And see! she stirs!
She starts,—she moves,—she seems to feel
The thrill of life along her keel,—
And, spurning with her foot the ground,
With one exulting, joyous bound,
She leaps into the ocean's arms!
And hark from the assembled crowd
Rises a shout, prolonged and loud,
That to the ocean seems to say,—
"Take her, O bridegroom, old and gray,
Take her to thy protecting arms,
With all her youth and all her charms!"

Sail forth into the sea, O ship!
Through wind and wave right onward steer!
The moistened eye, the trembling lip,
Are not the signs of doubt or fear!
Sail on, nor dread to breast the sea!
Our hearts, our hopes are all with thee;
Our hearts, our hopes, our prayers, our tears,
Our faith triumphant o'er our fears,
Are all with thee,—are all with thee! LONGFELLOW.

PURPOSE OF THE HUMAN BODY.

ALTHOUGH there are no two things more widely different than matter and spirit, yet it is manifest that this world of matter has been framed as a residence for beings with souls. If, in journeying across a desert, you came upon a Building which had doors, windows, chimneys, and numerous rooms furnished with chairs, tables, and bedsteads, you would not believe, even if told so, that it was designed to be merely a stable for horses, or a kennel for dogs; you would confidently infer that it was a human habitation. The same inference is suggested by the peculiar structure and accommodations of this Fabric which we call the earth. Sunsets, such as nature paints on the western sky, cannot have been intended for "the brute unconscious gaze" of sheep and oxen. Veins of metal and beds of marble are as far beyond the requirements of a mere animal abode as the bullion in the cellars of the Bank of England is beyond the requirements of a cow-house. And what of the vast subterranean beds of coal? Do not they foretoken the human uses of our planet as surely as a well-stored coal-cellar would foretoken the human uses of the house to which it pertained? In truth, look where we may, we observe spectacles which mind alone can enjoy—phenomena which mind alone can appreciate—raw materials which mind alone can work up into serviceable products.

But it is equally manifest that beings with souls alone—mere spiritual essences—would be quite unfit for such a material abode as this. Suppose the earth to be peopled with ghosts, what possible provision could it furnish for their convenience and comfort? Could the finest sunsets yield any delight to beings who had no eyes to see them? All the coals deposited in the vaults of the carboniferous era would be thrown away upon personages who could neither feel heat nor catch cold. Fruits would hang idly on the trees, for ghosts have no hands to pull apples. Horses would roam at large over the earth, for ghosts have no legs to bestride them.

In order, then, to fit human intelligences for the earthly home prepared and garnished for them, it is indispensable that they should be provided with some apparatus to bridge over the gulf between mind and matter—some *go-between* to bring their spiritual nature into communication with their physical abode—but what sort of apparatus?

As a first step towards bringing a human spirit into communication with the material world, he must be clothed with matter—furnished with a corporeal suit. One hundred and fifty pounds of dust must be taken from the soil and fashioned into an envelope for his soul. Accordingly we read in Holy Scripture, that "the Lord God formed" the first man "of the dust of the ground."

As a second step, it is necessary that this dust-body be endued with that mysterious something which we call life. And experience shows that, the moment this is done, the fabric of dust acquires properties which not only difference it from other material substances, but raise it immeasurably above them. The contrast between a corpse and a living body may suggest some idea of the wondrous change which the infusion of life makes on the matter of which the human body is composed. Endued with life, it ceases to be inert and torpid; it becomes sensitive and active; it becomes susceptible alike to the influences which address it from without, and to the bidding of the spirit which is to rule it within.

Nor is a body composed of terrene matter and saturated with life all that a human spirit needs to equip him for his earthly home. He also needs a sensory apparatus—a brain, nerves, and organs of sense. It is within "the ivory palace of the skull" that the Soul holds his court; and that pulpy mass, the Brain, is the chamberlain who alone has the privilege of giving the *entrée*. To the Brain, then, all messages from the outer world must come, if they would reach the Soul, and by the Brain alone can they be communicated to the Soul. But how are such messages to get to the Brain? For this end there is a ramification of fine white chords called nerves, which extend, like so many telegraphic wires, from the surface of the body to the Brain; and at their points of insertion in the surface of the body, there are, as it were, telegraphic stations,—that is, organs of sense, to receive the messages which outward objects may have to send within. So that the method of communication between the external world and the Soul is just this:—An outward object—say a tree, a thunder-peal, a floating perfume—brings its message to the organ of sense, situated at the surface of the body; the message is then intrusted by that organ of sense to the telegraphic wire or nerve; and by that wire or nerve it is transmitted to the terminus in the Brain, which in its turn communicates it to the Soul.

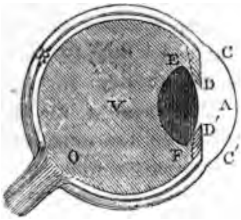
But a human spirit requires not only to hold converse with the world of matter, but also to act upon it; and to enable him to do so, he needs a further apparatus of bones and muscles and motor-nerves. His Maker, accordingly, has endowed him with a muscular as well as with a nervous system. And so admirably are these systems adapted to each other and to their respective functions, that the Soul has only to name his behests to his chamberlain in order to have them forthwith performed. By means of the motor-nerves, the Brain conveys the orders to the muscles; the muscles, by their contractile power, move the bones to which they are attached; and the bones are so richly furnished with joints and hinges, and other mechanical appliances, that they instantly set in motion the hands, or whatever else is requisite, to execute the orders.

Compiled.

THE SENSES.

Seeing.—WHAT would be the first act of Adam in Eden when he became a living soul? Would it not be to look around him? The first thing, then, which is needed to fit a human spirit for communication with the external world is, that he should be able to see. Accordingly, a special organ, the Eye, has been contrived for this end.

The eye is a hollow globe, partitioned into three chambers. In front, facing us, is the window on which the light from external objects first impinges. This window, called the *cornea*, resembles the glass of a watch, and admits the light to the first chamber, which is filled with water, and named the *aqueous humour*. Immediately behind this chamber, and partitioning it from the second, is a circular screen, called the *iris*, beautifully coloured, and perforated in the centre by a hole, called the *pupil*, which can be made larger or smaller by the contraction or relaxation of the iris, thus regulating the quantity of light to be admitted. Through this little hole or pupil the light passes into the second chamber, where it strikes upon the *crystalline lens*; through which lens, again, it passes—suffering refraction in its transit—into the third, or back chamber, where it comes in contact with the *vitreous humour*; and, having made its way through this, it at last reaches that fine membrane, the *retina*, on which it instantly photographs an exact picture of the external object.



C C′, the cornea.
A, the aqueous humour.
D D′, the iris, in the centre of which is the pupil.
E F, the crystalline lens.
V, vitreous humour.
O, the optic nerve.
R, the retina.

Thus far the eye is just a highly-finished camera for taking likenesses. But it has various appendages, possessed by no camera, and peculiar to itself. That it may see on all sides, it is furnished with muscles to move it horizontally, vertically, and obliquely. That it may widen or narrow the pupil according to the state of the light, it is furnished with the sensitive contractile iris; and it has an arrangement to enable it to accommodate its focus to the varying distance of objects. Nor is this all. To protect it from injury, it is lodged in a socket of strong bones, and lies cushioned upon soft fat. It is still further sheltered by the eye-brows,—an arch of hair which prevents the sweat of the forehead from running down into it. And, still better to defend it, as well as to close it in sleep and keep it clean by day, it is furnished with those soft, elastic, and finely-fringed curtains, the eyelids, which alternately rise and fall in the process of winking. "An outside window," as Dr George Wilson remarks, "soon gets soiled and dirty, and a careful shopkeeper cleans his windows every morning. But our eye-windows must never have so much as a speck upon them, and the winking eyelid is the busy apprentice who, not once a-day, but all the day, keeps the living glass clean." Nay, as if even this were not enough to keep the eyes clean and bright, a *gland* is situated at the upper and outer corner of the socket, which constantly pours a watery secretion across the eyeball; and, lest too much should be supplied, there is a perforation through the bone, by which the superfluous fluid is conveyed away to the nostrils and there evaporated;—a contrivance this last, which may well lead us to ask with Paley, "Can any pipe for carrying off the waste liquor from a dye-house be more mechanical?"

But, in order to vision, more is needed than all the apparatus yet described. Before external objects can be seen, the copies of them painted on the retina must be conveyed to the mind. How is this accomplished? The retina, which is in shape like the cup of a water-lily, ends like that cup in a stem; and this stem, called the *optic nerve*, passes from the retina through the back part of the eye, and then pursues its way till it enters the brain. The optic nerve is thus the telegraphic wire which connects the retina (itself an expansion of the nerve) with the brain; and along it the successive pictures photographed on the retina travel on to the headquarters of the soul. But here we tread the region of mystery. The optic nerve is but a fagot of minute tubular filaments of the same substance with the brain:—can we understand how such a fagot of threadlike nerves should be able to forward likenesses of outward things to the brain? What would you think if, placing a portrait of Queen Victoria at the London end of the Magnetic Telegraph, you were to find an exact copy instantly taken, and conveyed along the wires, and reproduced at the Edinburgh station? Yet this were nothing to what is done by the optic nerve. For that nerve not only copies, so to speak, all the pictures photographed on the retina, but reduces or contracts them so as to suit them to its own calibre, and then conveys them to the brain in all their details and without the slightest distortion. Here, indeed, is a deep mystery; and the mystery only deepens when we reach the final step—the cognition of the pictures by the soul. The brain is not the soul,—it is merely the soul's prime minister. What takes place between the two we cannot even surmise. Into that chamber where the soul communes with its servant, the brain, we try to peer and pry in vain. What wonder that we cannot search "the deep things of God," when we are such complete strangers to what we ourselves do within our own skulls?

By means, then, of these connected instruments—the eye, the optic nerve, and the brain—a human spirit is enabled to *see*. But *what* does he see? Does he see the trees, the houses, the hills? He sees only those portraits of them which the retina has taken, and the optic nerve has transmitted to the brain. What he sees is not anything without, but something within himself. You think you see the book you are reading; but you do not. What you see is only a little picture of it hanging on the back wall of your eye-chamber.

Nor do we see *distance*, though we may think so—nor *perspective*. For our knowledge of these is gathered, not from the organ of vision, but from experience, or rather from the mind's revisal of the impressions of sense. When an infant first begins to use its eyes, it sees only a confusion of colours; it gazes about with a vague, uncertain stare—plainly showing that no object is *individually* distinguished. It is the same with a person who, born blind, acquires the use of his eyes in adult life. To such a person every object at first appears either to touch his eyes or actually to form part of himself, and all objects seem flat and equidistant. One young man who, by a surgical operation, obtained sight at the age of twenty, supposed that the moon, which he saw rising behind a wood, touched the wood, and he even thought of climbing up one of the trees that he might lay hold of it. Another person, on obtaining sight, could not comprehend how his hand, as he drew it towards him, grew always bigger and bigger. And similar must have been the experience of the blind man of Bethsaida, who, when our Lord, after healing his blindness, asked him if he saw aright, looked up and said, "I see men as trees walking."

It is probably owing to a like mental supervision of the impressions of the eye, that we have single vision, notwithstanding we have two eyes. You look at that book; each of the eyes receives on its retina an image of the book, and sends it to the brain; so that there are really two copies of the book in your brain. Yet you see only one. That this result is due to the corrective action of the mind seems to be proved by the fact, that when the mind ceases to control the motion of the eyes, there is either no vision at all or double vision. The drunkard, whose mind has become so stupified by his debauch as to unfit him for supervising the impressions of sense, is often greatly embarrassed by the duplicate glass or the duplicate bottle he has to handle. And every one has read of the two members of Parliament who, while entering the House of Commons, arm in arm, after a carouse, were overheard saying—the one, "I can't see the Speaker"—the other, "I see two Speakers."

But when the eye is under the full direction and control of its intelligent owner, what an inestimable boon is it to him! For his benefit it takes portraits of all comers. Up the narrow avenue of nerves, which leads to his sequestered retreat in the brain, it sends in ceaseless succession the grandeur and glory of creation—the sun, the moon, the stars, the glowing bow in the cloud, mountains, forests, green meadows, and the dark blue main. It sends him, too, the works of human art—palaces, temples, ships, engines, statues—and, more precious still, the words of departed sages, who have left their minds in print for his instruction and delight. It is indeed a godlike gift, this visual organ. It is the principal bridge which has been thrown across from the realm of things to the realm of thought.

Hearing.—This world of ours is a world of Sounds as well as of Sights. Air, when thrown into vibrations by the action of external forces, emits and conveys sound. And therefore, if an organ can be constructed to collect those aerial vibrations and transmit them to the brain, a second sense may be produced, which shall do with them what the eye does with the undulations of light. The *Ear* is such an organ; and though it has to deal with a grosser fluid than light, its mechanism is not less marvellous than that of the eye. That shell-like convoluted cavity, which popularly goes by the name of the ear, is only the porch of the organ, and has for its office simply to collect the aerial vibrations and concentrate them on the ear proper. The chief parts of the organ are hidden within the head, and are so complicated, that no verbal description can convey a precise idea of them. From the outer porch there extends inward a series of intricate passages and curious chambers, partitioned by thin elliptical membranes that vibrate and tremble at the touch of air, like a tambourine when struck by the fingers. There are also curious little bones to tighten or relax these eardrums so as to accommodate them to the varying force of the aerial current. And in the innermost place of all there are rows of fine thread-like nerves which stretch, like the strings of a piano, from the last point which the vibrations reach, and then pass inwards. These nerve-strings are to the ear what the retina is to the eye: they are the outer extremities of the auditory nerve; and from them that nerve receives the sonorous tidings which it telegraphs to the brain.

The structure of the ear does not, any more than the structure of the eye, explain the secret of its operations. We know, indeed, that the aerial vibrations which flow into the outer porch do thence roll up the tunnel-like passages and vaulted chambers—resounding as they go—until they strike upon the nerve-strings of the instrument. But how the auditory nerve is able to take note of the manifold sounds which are evermore reaching it, and report them, without the slightest confusion or inaccuracy, to the brain, we cannot even conjecture. How marvellous is it that a speech of Brougham or a sermon of Melvill should be taken down and reported with all its articulations and cadences by a few slender nervous filaments! How amazing that the same tiny fibrils should take up and carry to your sensorium now a merry peal of laughter and now a stifled sob of grief —now the chirp of the grasshopper and now the massive harmonies of the Hallelujah chorus! Yet our ignorance of the secret of the ear's power does not lessen our knowledge of its actual power and invaluable uses. Great as are the advantages which we derive from the eye, they are perhaps exceeded by those which come to us through the ear. Those who are born deaf are more to be pitied than those who are born blind. The deaf as a class are usually dull, sullen, suspicious, while the blind are lively and cheerful;—and no wonder; for to be cut off from communication with the visible world is no such calamity as to be cut off from fellowship with our human brethren.

Smelling.—This world of Sights and Sounds is also a world of Smells. Many substances throw off volatile particles which yield effluvia. Liquids are continually emitting their vapours; plants their aromas; animals their flavour; dead bodies their gases. And to enable man to distinguish the qualities of the odours amid which he breathes, he requires to possess the sense of smell.

The nose, the organ of this sense, consists of two vaults or cavities, open to the external air. These cavities—called the nostrils—are lined with a fine soft membrane, resembling the inside of the mouth; and over this lining is spread a ramification of nerves which collect into two trunks at the roof of the nostrils, and thence pass up through apertures made for them, until they terminate in the brain, where they discharge the cargo of sensations with which they may be freighted. Two conditions are necessary to the efficiency of this organ. One is, that there be a current of air passing up the nostrils, to make the odorous particles impinge on the nerve-clad lining; and this condition is met by a funnel which connects the nostrils with the lungs. The other condition is, that the nerve-clad lining be kept always moist; and this, again, is effected by glands that secrete a liberal supply of mucus. Why such constant lubrication is needed, we cannot explain; but its necessity is undeniable. For whenever the supply of mucus is suspended, as it is in some catarrhal affections, the owner of the nose may walk through the city of Cologne without detecting any one of the seventy-two stenches which, if Coleridge is to be believed, salute you there in every street.

Of all the organs of sense the nose is the one held least in honour. By some it is thought so useless for anything else that they turn it into a snuff-box; and by others it is selected as a butt for all manner of jokes. Yet it has a very important office to fulfil; and that prominence of position on the human face, which exposes it to so many rubs from the caricaturist and the quiz, serves at once to indicate the office and to aid the organ in performing it. Placed at the outer end of the tunnel leading to the lungs, the nose has to intimate to the brain the approach of any volatile substances which may be unsuitable to the system. Its business is to snuff up the tainted air, and report concerning it to the brain. It is an outpost ever on the watch for any suspicious odours that may be abroad; it is "an official inspector of nuisances." And this useful office it never fails, when in good working order, to perform most efficiently. For though the odours which are evermore gushing from the surface of the globe are absolutely innumerable, yet so sensitive and nicely discriminative is the despised proboscis, that it instantly translates them all into equivalent sensations, and gives the mind distinct warning at once of what noxious vapours are stealing from the soil, and of what spicy treasures are afloat on the breeze.

It is true that when long acted on by strong odours, the nerves of smell lose their sensitiveness. After a time, sweet perfumes pall upon us, and noxious gases cease to be offensive. But this law of hebetation, so far from unfitting the organ for its office, only brings out more strikingly the skill and care of the Creator in adapting it to our condition in a world to which we have been sent, not for pleasure, but for work. "The palled perfume," as Dr George Wilson finely remarks, "tells us that but little of our time may be spent in merely pleasing our senses; the tolerated infection bids us sit by the sick man's side, and set the preciousness of his life over against a little discomfort to ourselves. And so it is that, while the listless voluptuary flings away the rose which to him has become scentless, the metal-worker labours heartily among the vapours from his crucible, and the bleacher inhales without a murmur the fumes of his chlorine; while, most tried of all, the busy anatomist asks no one for pity, but forgets the noisome odours about him in delight at the exquisite structure he is tracing."

Tasting.—Closely allied to the sense of Smell is the sense of Taste. If we require to be forewarned of the flavour of the air which is seeking to enter our lungs, we equally require to be forewarned of the savour of the food which we are invited to take into our stomach. We need, therefore, a warder for the stomach as much as a warder for the lungs. And such a warder is the sense of taste.

The organ of this sense is the tongue. The nerves which transmit the sensation to the brain overspread the upper surface of the tongue; and at various parts, but especially at the tip, these nerves cluster in little bunches, called *papillae*, which rise and protrude so as to roughen the tongue when a sapid substance touches them; the papillae being further stimulated by contact with the palate. The tongue has also nerves of motion, and glands to keep it moist, with various other contrivances to fit it for its office. Unfettered by any joint, it can take all shapes and move in all directions, so as to adjust the food between the grinders; and so fine is its mobility and lubricity, that, though placed in a perilous situation, with the work of grinding going on all around, and with little room to keep clear of the formidable machinery, it is able to ply its office without meeting with any accident, except on those rare occasions when a man is so rabidly voracious as to "bite his tongue."

Thus equipped, this little warder lies couching in his lodge at the gate of the alimentary canal, until some visiter in the shape of a sapid substance, solid or liquid, knocks at the gate. Forthwith he arises and makes trial of the quality of the new-comer. With unerring tact, he ascertains whether he be, or be not, fit company for the great folks in the hall of digestion; and, before opening the gate, he sends intimation of the quality of the stranger to his Master in the brain, that the Master may judge for himself whether to receive or decline the proffered visit. Unfortunately both for the stomach and for the brain, the report of the warder at the lodge is not always deferred to; and occasionally, therefore—nay, very frequently—visiters get in, who cause disorder in the hall of digestion and confusion in the palace of the skull. But, in all such cases, our warder has the privilege of protesting and recording his protest. For, by a singular provision in the human system, the tongue, whenever food or drink is taken other than it commends and sanctions, becomes coated and discoloured, and so bears witness at once to its own faithful discharge of its office, and to the reckless conduct of its self-willed master, the mind.

To this sense, though but too often perverted to unworthy uses, society is, in a large measure, indebted for the advance of the arts and amenities of life. The history of man's bill of fare is in great part the history also of geographical discovery and commercial progress. One, at least, of the causes of John Bull's high position in the world is "the roast-beef of Old England."

Touch.—As Seeing brings us acquainted with the visible in external objects, Hearing with the audible, Smell with the odorous, and Taste with the sapid, so Touch brings us acquainted with the tangible. In common with the other senses, Touch has a system of nerves to connect its organ with the brain; but it differs from the others in this, that its organ is neither of complicated structure, nor confined to one limited part of the body. There would obviously be no advantage in the whole surface of the body being an eye, or an ear, or a nose, or a tongue; it is sufficient that light, sound, odour, savour, have each but a single door of entrance. But since touch is designed to apprize us of the impact of external things upon any and whatever part of the body, it is requisite that its organ should be expanded over the whole frame. And it is so. The skin is the organ of touch; and the skin, as we know, is a garment which clothes us from head to foot, and which, moreover, is sensitive throughout, as is clear from the fact, that there is no part of it which can be pricked with a needle without our feeling pain.

The nerves of touch, however, though diffused over the whole skin, are not equally diffused. At some parts there is a thick cluster of nerves, and consequently peculiar sensitiveness. The fingers are exquisitely gifted, as we might expect from their vocation; and the lips and the tip of the tongue are also plentifully endowed. Indeed, the ends of the fingers and the tip of the tongue have been ascertained by experiment to be eighty times more sensitive to touch than the middle of the arm or thigh. Other parts of the skin, again, are so comparatively insensitive, that the mere contact of external objects, if long continued, is—as, for instance, in the case of our clothes—scarcely felt at all.

There is another remarkable difference between touch and the other senses. Each of the others yields but one class of sensations; touch yields a wide range of sensations —some of them even opposite. Press a body against the hand, and the feeling of mere touch passes into pain; apply it sharply, and heat is felt; apply it lightly and rapidly, and a sense of tickling is felt, and sometimes a sense of cold. The crawling of an insect over the skin causes a sort of cold shiver. A schoolboy who handles the "taws," merely as an object of curiosity, is conscious of only a cool feeling of touch; but when that leathern instigator to learning comes sharply down upon the tips of his fingers, the wry face of the urchin shows that he would as lief have handled a bit of burning coal.

It may be added that of all our senses touch furnishes the best illustration of the remarkable law, that we instinctively refer our sensations, not to the mind, where they are really felt, nor yet to the nerves which convey them to the mind, but to the part of our body where the stimulus is applied. It is quite certain that just as we see, hear, smell, taste, not with the bodily organ, but only with the mind, so our sensation of touch is not in the skin, but in the mind. Yet our impression invariably is, that the periphery of the body is the seat of feeling. The pain which was excited in your toe when that big fellow trod on it (as he said, by mistake) was felt, not by your toe, but by your mind; yet you firmly believe that the pain was down in your toe. That old soldier who left both his legs in the trenches before Sebastopol, and has now only two wooden stilts instead, will insist upon it that he sometimes feels cramp in the calf of his right leg. And most wisely ordered is it that such should be the law of our sensations. For it is just this feeling of *outness*—this instinctive tendency to ignore the intermediate machinery of the nervous system, and go direct to the objects whence the impressions arise—which enables the mind and the external world so easily to meet and hold intercommunication. *Compiled.*

A PUBLIC MEETING NOT REPORTED IN THE NEWSPAPERS.

THE Mental Powers and the Five Senses, having long and fruitlessly complained in secret of the arbitrary and oppressive rule of their common master, Man, at length resolved to meet in open assembly, to discuss their grievances, and agitate for redress.

The chair was occupied by that distinguished intellectual faculty, JUDGMENT, who, after a few introductory remarks, called on CONSCIENCE to stand forth and declare his grievances.

CONSCIENCE spoke as follows:—"Mr Chairman, the office which I have the honour to fill is, as you know, that of moral assessor or mentor to our Master. It is my duty to expound to him the law by which he should walk—to apprize him of the difference between right and wrong, to commend him when he does right, and to check and chastise him when he does wrong—and this arduous and invidious duty I am always ready to perform without fee or reward. But how does our Master treat me? Why, instead of being grateful for my good counsel, he often refuses even to listen to me; and when he cannot help hearing me, he stops his ears. Nay, he sometimes puts a muzzle on my lips, and when that fails to silence me, he tries to drug me asleep with some vile narcotic. So much does he dread and dislike my admonitions, that he shuns me as often as he can, and sulks whenever I approach him. In short, he treats me as if I were his worst enemy."

"But don't you sometimes make reprisals?" asked the Chairman. "Certainly I do. It is my duty, as I have already stated, not only to counsel our Master, but also to check and chastise him when he takes a course opposed to my advice; and so, when his conduct calls for it, I do not hesitate to prick him with the sting of self-reproach, or even to scourge him with the lash of remorse. But then I do this, not from any vindictive feeling, but from benevolent concern for his good. His bad behaviour, while a grievance, is still more a grief to me. And nothing would afford me truer pleasure than to see him pursue a course which would leave me no further ground or room for upbraiding and tormenting him."

CONSCIENCE having resumed his seat, MEMORY next stood forth. "My function," he said, "is confessedly inferior in rank to that of the preceding speaker,—though CONSCIENCE himself must admit that it is an important function—nay, so important that without it his own could be but indifferently discharged. To me it belongs to remind our Master of the past—to recall to him all he has seen, and heard, and read, and said, and done. Without me he would be unable to remember even his mother-tongue, or to recollect the faces and names of his children. I lay up and retain for him, as in a coffer, all that occupies and interests him—all his knowledge and experience—and so entirely are my services at his command, that I am ever ready, the moment he wishes it, to hand him for his use whatever my stores contain. Now, I do not object to being thus used as a store-room, nor do I complain of the quantity of materials he commits to my custody. On the contrary, the fuller my stores, the better am I pleased, if the contents be really valuable. But my objection, my complaint, my grievance, is, that he makes me for the most part a mere lumber-room—nay, a receptacle for rubbish and garbage. I desire, I delight to have my repositories filled with sound learning, with useful knowledge, with good words and worthy deeds. But our Master, in place of allowing me to treasure up only such things as these, keeps me almost constantly employed in accumulating all manner of hateful things—evil thoughts, idle words, wicked deeds. Is not this very hard? You would deem it almost sacrilege to turn a palace into a tavern, or a church into a playhouse, or a museum into a pawnshop. Yet these were but faint emblems of the degrading uses to which I am put. Can you wonder that I recoil from such degradation, and long for redress?"

IMAGINATION next rose, but resumed his seat at the request of the Chairman, who said, that enough had been already stated to enable the meeting to judge of the grievances of the Mental Powers. "The speech of IMAGINATION," he added, "may be safely reserved for some future occasion, when we have time to listen to fancies as well as facts. Meanwhile it is but fair to hear what the SENSES have to say."

Upon this the EYE rose, and craved, in behalf of himself and his brother-senses, to be heard by counsel. "None of us," he said, "is accustomed to make speeches. But there is a gentleman present—a friend of yours and ours, and, withal, a fellow-servant—who, possessing the gift of ready utterance, is well able, if you will allow him, to plead both his own cause and ours."

This request having been granted, TONGUE stepped forward and proceeded thus:—"Allow me, Mr Chairman, to begin by thanking you for the honour you have done me by permitting me to appear on this occasion,—an honour which I had no right to expect, being neither one of the Mental Powers nor one of the Senses; but of which I gladly avail myself, in order to say a few words in behalf of my five friends beside me, who, unhappily, are too diffident to speak for themselves. Residing, Sir, as I do, in the immediate vicinity of these gentlemen, and being, moreover, associated with one of them in the performance of his appointed function as *Taster* to our Master, I am well acquainted at once with the services they render, and with the treatment they receive; and, as the result of long observation and experience, I feel bound to say that, shameful as is our Master's conduct to yourself, Sir, and the other Mental Faculties, his conduct to these five gentlemen and myself is yet more shameful. The Mental Powers are able, when aggrieved, to make reprisals. CONSCIENCE can sting the aggressor with remorse; MEMORY can pierce him with the barbed arrow of regret; IMAGINATION can scare him with dismal fancies and forebodings; and YOU, Sir, in virtue of your high judicial function, can bring him to your bar, and degrade him in his own eyes, by making him see that he is a Fool. But the Senses and myself have no such means of defence. *We* are quite helpless; *we* have no alternative but to be always and everywhere his passive, unresisting slaves. And consider, Sir, to what a grinding and degrading bondage he subjects us. The EYE, instead of being allowed to pencil on its lovely orb only the grand and the beautiful, is compelled to paint for his inspection the hideous and the loathsome. The EAR, in place of having its vocal chambers always filled with the melodies of rejoicing nature, and the sweet cadences of good and gentle speech, is forced to entertain him with the harsh sounds of strife, the grating notes of blasphemy, the siren strains of licentiousness. Then think how scandalously my friend TASTING is abused by being made to pander to gluttony and drunkenness. SMELLING, too, and TOUCH—are not they obliged to stoop to daily fellowship with all manner of nastiness? And as for myself—who that has ever heard my voice does not know that I am daily required to utter falsehood, flattery, slander, cursing, ribaldry? I was given to our Master, that by my help he might bless God, speak the truth, and interchange good and kind thoughts with his fellows. But he has turned me to such base uses that I have lost my good name, and come to be denounced as 'an unruly evil, full of deadly poison,' nay, as 'a fire which setteth on fire the course of nature, and is set on fire of hell

But to dismiss my own wrongs, and return to those of my clients——"

TONGUE had proceeded thus far, when the Chairman, who well knew that the talkative little man, if allowed, would harangue till midnight, rose and beckoned him to stop, remarking that the wrongs of the SENSES were palpable to all, and that it was now time he should bring the proceedings to a close by briefly indicating his opinion as to the course that ought to be adopted in the further prosecution of their object.

Hereupon TONGUE, though manifestly chagrined and out of humour, returned to his seat, and the Chairman went on. "I will frankly confess," said he, "that, though I have willingly co-operated with my brethren and fellow-servants in bringing our grievances before the world, and trying to enlist public sympathy in our favour, yet I have but little hope that anything which the public may say or do will move our Master to do us justice. He is, indeed, alive to the opinion of the public, fond of its applause, and afraid of its censure; and possibly, when he learns that the general sentiment is against him, he may defer to that sentiment so far as to treat the SENSES and their eloquent advocate with less open disparagement than heretofore. But it is vain to expect that either applause or censure will induce him to redress the wrongs of CONSCIENCE or of MEMORY. There is 'a power behind the throne,' which public opinion cannot reach. In lording it over us, our Master is the unconscious dupe and thrall of that domineering and wayward Chamberlain of his —the WILL. His maltreatment of us is all owing to the malign influence of that unprincipled Major-domo, who is now, as he always has been, and ever will be, the real Ruler of the house. Until, therefore, that wicked One is humbled, and completely changed in temper and tastes, there can be no reasonable hope of our ever faring better; and since no power on earth can humble him—since no power out of heaven can change the WILL—our only effectual resource, in my judgment, is an appeal, not to the bar of public opinion, but to the throne of the Heavenly Majesty."

Thanks were then voted to the Chairman, and the meeting separated.

SONNETS.

WHEN I consider how my light is spent
  Ere half my days, in this dark world and wide,
  And that one talent which is death to hide,
Lodged with me useless, though my soul more bent
To serve therewith my Maker, and present
  My true account, lest he, returning, chide;
  "Doth God exact day-labour, light denied?"
I fondly ask: but Patience, to prevent
  That murmur, soon replies, "God doth not need
Either man's work, or his own gifts; who best
    Bear His mild yoke, they serve Him best; His state
  Is kingly; thousands at His bidding speed,
And post o'er land and ocean without rest;
    They also serve who only stand and wait."—MILTON.

AVENGE, oh Lord! thy slaughtered saints, whose bones
  Lie scattered on the Alpine mountains cold;
  Even them who kept thy truth so pure of old,
When all our fathers worshipped stocks and stones,
Forget not: in thy book record their groans
  Who were thy sheep, and in their ancient fold
  Slain by the bloody Piedmontese, that rolled
Mother with infant down the rocks. Their moans
The vales redoubled to the hills, and they
  To Heaven. Their martyred blood and ashes sow
O'er all the Italian fields, where still doth sway
  The triple tyrant; that from these may grow
A hundredfold, who, having learned thy way,
  Early may fly the Babylonian woe.—*Id.*

NUNS fret not at their convent's narrow room;
  And Hermits are contented with their cells,
  And Students with their pensive citadels;
Maids at the wheel, the Weaver at his loom,
Sit blithe and happy; Bees that soar for bloom,
  High as the highest Peak of Furness-fells,
  Will murmur by the hour in foxglove bells:
In truth, the prison, unto which we doom
Ourselves, no prison is: and hence to me,
  In sundry moods, 'twas pastime to be bound
  Within the Sonnet's scanty plot of ground:

Pleased if some Souls (for such there needs must be)
Who have felt the weight of too much liberty,
Should find brief solace there, as I have found.
WORDSWORTH.

EARTH has not any thing to show more fair:
Dull would he be of soul who could pass by
A sight so touching in its majesty:
This City now doth like a garment wear
The beauty of the morning; silent, bare,
Ships, towers, domes, theatres, and temples lie
Open unto the fields, and to the sky;
All bright and glittering in the smokeless air.
Never did sun more beautifully steep
In his first splendour valley, rock, or hill;
Ne'er saw I, never felt, a calm so deep!
The river glideth at his own sweet will;
Ah me! the very houses seem asleep;
And all that mighty heart is lying still!—*Id.*

THE CHARACTER OF CHRIST.

Is the Jesus of the Evangelists a real portrait, or only a fancy picture—an historical, or only an imaginary personage? Apart from the multifarious evidence, historical and critical, which learned men have collected and adduced in proof of the genuineness and credibility of the Gospel narrative, there is enough in the mere character of Christ as portrayed by the Evangelists, to exclude the hypothesis of an imaginative creation. If the authorship of an epic poem, or the construction of a ship of the line, were claimed for a savage of the woods, every man of sane mind would at once reject the claim, because of the palpable disproportion between such a work and the capabilities of a savage. On careful examination, it will be found that there is an equal disproportion between the evangelic portraiture of Jesus and the inventive powers of His biographers. For not only does Jesus rise upon us from the pages of the Evangelists with a graphic distinctness, which enables the reader to apprehend and realize His character far more precisely and vividly than any other character described in books, but that character is made up of features which, whether taken separately or in combination, are altogether without a parallel.

Look, for instance, at the *benevolence* of Jesus. Is there anything like it in the whole range of history? His is a benevolence so expansive, that it reaches to all men without distinction of country, or creed, or condition; so tender, that it descends to the humblest offices of kindness; so energetic, that it refuses to forego any opportunity of doing good; so superior to injury, that it pursues its beneficent path, unmoved by ingratitude or hostility, and even returns blessing for cursing. He stoops down to the sorrowful estate of man solely from a benevolent concern for our wellbeing; and though He descries beforehand, as from a height, the whole of the thorny path He has to tread, He never halts or falters till He has reached its termination at the bitter Cross. Can it be, that a benevolence so godlike suggested itself to human invention in an age when stoical insensibility was counted the perfection of virtue?

Or look at his *humility*. The greatest of characters, He is at the same time the gentlest. All the paths of human ambition are open to Him, yet He passes them by. All the kingdoms of the world and the glory thereof are in His offer, yet He rejects them. He takes the condition of the lowly. He disdains not to be the teacher and friend of unlettered fishermen, and the helper and comforter of publicans and sinners. He takes little children in His arms to bless them; He washes the feet of His disciples. And even when disclosing the profoundest truths, or performing the most stupendous miracles, He always appears in the same simple, beautiful garb of humility. Strange if this most winning feature of character was the mental offspring of persons born and reared in the very hotbed of Pharisaic bigotry and pride!

Nor is Christ's character more unprecedented in its separate elements than in their combination. Every reader of the Gospels is struck with the contrasts in our Lord's outward condition—the contrast, for example, between His lowly nativity and the angelic pageant which announced it—the contrast between the manger where He was cradled, and the star which lighted the way to it. His personal character presents like striking contrasts. In Him the lofty and sterner unite with the soft and gentle virtues. There is the towering grandeur of the Alpine precipice, but there is also the green and peaceful valley at its base. You behold in Him a self-sustained and commanding dignity, which isolates Him from all the men around Him; yet with this He conjoins the sweetest simplicity and condescension. You behold in Him an intense abhorrence of sin; yet compassion to sinners fills His heart and flows from His tongue. Nowhere else do you find such supreme devotion to a great enterprise; yet, instead of being chagrined by ill success, He bears opposition and disappointment with unruffled equanimity. Nowhere else do you find such an entire superiority to the need of earthly pleasures; yet, instead of displaying an ascetic temper, or frowning on human enjoyments, He joins freely in the genial courtesies and social festivities of life. Are such opposite qualities usually combined? Nay, does the whole history of mankind furnish another instance of their union? And, to increase the marvel, these seemingly incongruous elements never clash, never jar, never impair the *oneness* of the character. They always harmonize; they always unite in perfect apposition and concord; they always blend and combine like the prismatic colours in the ray of silvery light. There is no confusion and no distortion. See Jesus where you may—on the high walk of miraculous power or in the humble scenes of common life—with His enemies or with His friends—amid the glories of the Transfiguration or amid the dishonours of the Cross—you behold one and the same harmonious character; you recognise His unmistakable identity; you hear, as it were, a holy voice speaking to your heart, and saying, "IT IS I."

And then, besides being altogether peculiar, this character is absolutely perfect. It commends itself to our moral sentiments as consummately excellent; and, what is not less signal, it commends itself the more the longer we study it. It grows in beauty, in symmetry, in moral grandeur, as we gaze upon it. It advances in our admiration in proportion to the refinement of our sensibilities; and they who are holiest, appreciate it best and admire it most. The human mind has been in a state of progress ever since the days of Jesus, and society has long outgrown the religions, the ethics, the tastes, the modes of thinking, which then prevailed. But *His* character, instead of shrinking before the scrutiny of advancing intellect and refinement, has only attracted to itself additional admiration as ages have rolled on. Even infidels have been forced to confess its awful beauty. Like the presence of a holy shrine, it has often restrained impious hands from violating the sanctuary of our religion; and many who have scrupled not to sport with everything else in the Gospel, have passed by the character of Jesus in reverent silence.

This is the character which we find portrayed in the writings of the Evangelists—portrayed in all its sweet harmonies, in all its unmatched perfection, and with inimitable vividness and verisimilitude. Can credulity itself believe that the Evangelists could have painted such a portrait, had it not been a portrait from the life?

THE PHASIS OF MATTER.

A GROWING plant draws inorganic matter from the soil and the air, and incorporates that matter with its own organized substance and living frame. The plant is then devoured by some animal, and straightway converted into muscle, or nerve, or bone, as circumstances may prescribe. Erelong the animal dies, and if the particles thus obtained have not previously been dissipated, they return to the atmosphere and the soil—the reservoirs from which they were originally derived. This circulation goes on continually. Matter is ever flowing from the mineral to the vegetable, and from the vegetable to the animal, and from the animal back again to its native site. In passing, however, from kingdom to kingdom, the ultimate atoms never change their intrinsic character. The oxygen, hydrogen, carbon, and other elementary substances remain indelibly the same, despite the variety of combinations in which they successively appear. In nature's currency nothing is lost: she marks all her coin. Every atom that existed at the Creation is still existing somewhere, and might be called in at any moment in its pristine integrity.

In effecting these mutations all the physical forces are employed, and, in addition to them, the magical power of Vitality. With the laws and operations of the physical forces science is somewhat acquainted; but what Life is, and how it exerts its marvellous influence, science is unable to tell, and is never likely to discover. The fact, however, is unquestionable that to the proximate agency of forces, either physical or vital, are to be ascribed all the combinations and changes which the elements of matter undergo, whether in the rock, the soil, the water, the air, or in the structure of plants and animals.

Even within the limits of the mineral kingdom the law of material change and interchange is in constant operation. All the rocks of which the crust of the earth is composed, are ever, by slow but sure degrees, becoming disintegrated, and their substances passing into new conglomerations. But this is a tame phasis compared with that which occurs in bodies when they enter into organic structures. Then, the elements group themselves into complex compounds—compounds which art can analyze, but is utterly unable to reconstruct. The soil, which may be said to stand midway between dead and living matter—because from it animals and plants obtain by far the greater part of their frames—consists of substances in which the ultimate elements are much more variously and intricately combined than in the rocks where they previously existed; and still more various and intricate are the combinations into which these elements enter in the frame of vegetables and animals.

The numerous points of difference between plants and animals all serve to exemplify this grand law of circulation and interchange. One of the most prominent differences is to be found in the diet of the two. While the plant feasts on the earth, the animal cannot dine directly on the soil. The materials on which the latter subsists must pass through some vegetable form, in order that they may be worked up into gluten, oil, and other combinations, before they can be accepted and assimilated by the lordlier structures.

A second difference brings into view additional changes, at least in the case of animals. While vegetables, generally speaking, retain in their frames until death the inorganic matter which they take up as food, the animal fabric is subject to incessant flux and dissipation. Parts of it are undergoing dissolution every moment, to be again recruited by fresh supplies of food. In the case of the human animal the *whole* fabric is dissipated in the course of a few years; so that, in the range of a long lifetime, each individual wears out several suits of bodies, as he does several suits of clothes. In this process of ceaseless change the Vital Principle is the chief worker; and his working is the more marvellous that it proceeds without our being aware of it. Though the corporeal houses we inhabit are pulled down, stone after stone, and rebuilt as fast as they are destroyed, yet no eye can follow the process. The masons and carpenters are never off our premises for an hour, and yet the chink of their chisels or the grating of their saws is entirely unheard. And still more striking is the fact, that the very organs which are the main instruments in effecting these changes are themselves silently renewed without interrupting their functions for an instant. The heart is reproduced out of our food without losing a single beat, and without spilling a solitary drop of blood. The eye is taken to pieces, time after time, and the windows of vision reglazed, without disturbing our sight for a day; and new stomachs are repeatedly inserted in our bodies without our ever being compelled to abstain from digestion, until the apparatus can be properly replaced.

One other point of difference between plants and animals may be mentioned, as illustrative, if not of the phasis of matter, at least of the broad distinction between the merely unconscious, passive life of the plant, and the conscious, sensational life of the animal. Plants exercise no choice in selecting their food. Whatever fluid is presented to their rootlets, be it noxious or salutary, it is indiscriminately absorbed. But every animal above the class of sponges has the power of rejecting or accepting substances presented to it. Nor let us here overlook the remarkable instinct which

God has implanted in animals, and especially in man, to enable them to exercise aright their power of choosing their food. As the human body is composed of a certain set of elements united in certain proportions, it is indispensable that the food we consume should contain the precise ingredients of which the body is composed. No substances but those of which the body consists can feed the body, nourish it, repair its constant waste. Yet men have been dining for thousands of years in ignorance alike of their own chemical constitution and of the exact composition of their viands. We take pains to procure a dinner daily; but nobody ever asks whether it contains (as it were) bricks for the walls, timber for the floor, glass for the windows, or marble for the mantelpiece. We must, in some way or other, contrive to procure iron for the blood, sulphur for the hair, and phosphorus for the brain; but at no table in the kingdom do we ever find these indispensable articles appearing in the bill of fare. How, then, explain the fact that so many millions of human bodies have been repaired without difficulty and without mistake? We can only ascribe this remarkable result to a kindly Providence, which has not merely spread a table for us, but has also implanted a subtle instinct in our nature, which, when discreetly followed, attracts us to what is chemically congenial, and repels us from what is useless or injurious.

Since animals have food provided for them of the same ingredients as their bodies, and are able by the use of that food to repair the constant waste of tissues and organs, it might be expected that their bodies would never wear out, but always subsist under a process of alternate demolition and reconstruction. And probably this would be the case, if the vitalizing principle continued to abide and to exert its force. But the fact is very different. At last disease and death arrive. The vital power being withdrawn, the precarious alliance into which the material elements had entered begins to dissolve, and the body of the animal breaks up. The nitrogen of the albuminous compounds deserts its late comrades to combine with hydrogen and form ammonia; another portion of the hydrogen unites with carbon to produce carburetted hydrogen, and more hydrogen combines with sulphur to yield sulphuretted hydrogen. Thus the constituents of the body are disbanded, and thus, too, the glorious shapes, which once walked this earth in all the pride of strength and superiority, vanish in fetor and putridity. Back they go—though but recently the home of intelligence, the dwelling-place of the soul, the seat of genius—to the insensate dust beneath, and to the atmospheric charnel-house above. Through this ordeal of putrefaction our frames must all pass to the realms of lifeless matter. The hand that writes this sentence was once earth such as we all trample on, and soon will be earth again, and perhaps, ere the writer's name has been forgotten by surviving friends, will be transformed into the cypress of the cemetery, or the daisies of the country churchyard. The matter, too, of that eye which reads this sentence was allied a little while ago to the elements of inorganic matter; and the time cannot be very distant ere some have to mourn at those terrible words read over it—"Dust to dust and ashes to ashes."

Compiled from KEMP.

VASTNESS OF THE UNIVERSE.

APART from all consideration of the mechanism of the solar and stellar systems, and of the countless number and marvellous structure of the organized beings that people them, there is enough in the mere *quantity of matter* in the universe to impress us with a profound sense at once of the vastness of Creation, and of the almightiness of the Creator.

The earth is a globe about 8000 miles in diameter, and 25,000 in circumference; and, consequently, its surface contains nearly two hundred millions of square miles,—a magnitude too great for the mind to take in at *one* conception. Were we to take our station on the top of a mountain of moderate size, we should perceive an extent of view stretching 40 miles in every direction, forming a circle 80 miles in diameter and 250 in circumference, and comprehending an area of 5000 square miles. In such a situation, the scene around us—consisting of hills and plains, towns and villages, rivers and lakes—would form one of the largest objects which the eye, or even the imagination, can steadily grasp at one time. But such an object, grand and extensive as it is, forms no more than the *one forty-thousandth part* of the terraqueous globe; so that, before we can acquire an adequate conception of the magnitude of the world, we must conceive 40,000 landscapes of a similar extent to pass in review before us. Allotting twelve hours a-day to the task, it would take us 8 years and 48 days to survey the whole surface of the globe, even in this cursory manner.

These remarks apply to the earth as a mere superficies. But the earth is not a mere superficies, it is a globe, whose contents amount to well nigh 300,000,000,000 cubical miles. Were the earth a hollow sphere, surrounded merely by an external shell, 10 miles thick, its internal cavity would be sufficient to contain a quantity of materials *one hundred and thirty-three times* greater than the whole mass of continents, islands, and oceans, on its surface, and the foundations on which they are supported. We have the strongest reasons, however, to conclude, that the earth, if not a solid mass from the surface to the centre, has, at least, a solid exterior crust of two or three hundred miles in thickness. What an enormous mass of materials, then, is comprehended within the limits of that globe on which we tread! How great must be the power of that Being who spake the earth into existence by His word, and "hangeth it upon nothing!"

When we contemplate, by the light of science, those planetary bodies which, along with our globe, revolve around the sun, the earth dwindles into an inconsiderable ball. One of those planets is more than 900 times the size of our world, and encircled with a ring which would nearly reach from the earth to the moon; and another is of such a size, that it would require 1500 globes of the bulk of the earth to form one equal to it in dimensions. The sun himself is 1,300,000 times larger than the terraqueous globe.

But the solar system, stupendous as it is, occupies only a small portion of the expanse of space. Even to the naked eye that space is seen to be peopled by nearly a thousand starry bodies of a character quite different from those that move around our sun. The telescope brings into view not merely thousands but millions of these bodies. The great zone of the Milky Way, which has in all ages arrested attention from its peculiar appearance, is found, on the application of the telescope, to be nothing else than a pathway of stars so densely crowded as to be separately indistinguishable to the unaided eye. Herschel informs us that "in one quarter of an hour's time there passed no fewer then 116,000 stars through the field of view of his telescope." Yet all these countless orbs are suns similar to our own, with attendant planetary trains. Every one of those fixed stars, which seem only so many brilliant spangles on the drapery of night, is the luminous centre of a system far exceeding, in many instances, that to which our globe belongs. The star Sirius, for example, which is equal to sixty-three suns, must irradiate and control a planetary system much vaster than our solar one.

Nor do the fixed stars, though millions in number, and each the centre and sun of a system of worlds, exhaust the stellar universe. In various quarters of the heavens the telescope has discovered patches of dim, hazy light, now well-known by the name of *Nebulae.* Some of these were from the first believed to be dense clusters of stars, only rendered indistinct and nebulous from their immense remoteness; others, however, were supposed to be portions of diffused gaseous matter in the course, as was conjectured, of being condensed into stars. But by means of Lord Rosse's magnificent telescope, these nebulous masses, previously irresoluble, have been at once resolved. What seemed only dim patches of twilight haze, as yet unformed into suns, are discovered to be already systems of countless suns glowing with ancient fire; and the conclusion to which these nebulous phenomena inevitably point is, that the starry firmament, of which our solar system is a part, is only one of the innumerable galaxies of firmaments which people the tracts of space. The millions of suns which light up our nocturnal sky, and the millions of planetary systems attached to them, are, after all, when compared with what lies in the immeasurable spaces beyond, only as a raindrop to the ocean.

Here, then, with reverence, let us pause and wonder! How great beyond all conceivable idea of greatness must He be, who by His almighty fiat caused all this vast assemblage of material things to emerge from nothing into existence, and evermore upholds it, with all its complicated movements! Surely that man is little to be envied who is not impressed, by such contemplations, with an overwhelming sense of Creative Power. *Compiled.*

SPECIMENS OF THE POETRY OF THE NINETEENTH CENTURY.

(*Chronologically arranged.*)

THE lark has sung his carol in the sky,
The bees have hummed their noontide lullaby;
Still in the vale the village-bells ring round;
Still in Llewellyn-hall the jests resound,
For now the caudle-cup is circling there,
Now, glad at heart, the gossips breathe their prayer,
And, crowding, stop the cradle to admire
The babe, the sleeping image of his sire.
  A few short years, and then these sounds shall hail
The day again, and gladness fill the vale;
So soon the child a youth, the youth a man,
Eager to run the race his fathers ran:
Then the huge ox shall yield the broad sirloin,
The ale, now brewed, in floods of amber shine;
And, basking in the chimney's ample blaze,
'Mid many a tale told of his boyish days,
The nurse shall cry, of all her ills beguiled,
"'Twas on these knees he sate so oft and smiled."
  And soon again shall music swell the breeze:
Soon, issuing forth, shall glitter through the trees
Vestures of nuptial white; and hymns be sung,
And violets scattered round; and old and young,
In every cottage-porch with garlands green,
Stand still to gaze, and gazing bless the scene;
While, her dark eyes declining, by his side
Moves in her virgin veil the gentle bride.
  And once, alas! nor in a distant hour,
Another voice shall come from yonder tower;
When in dim chambers long black weeds are seen,
And weepings heard where only joy has been;

When by his children borne, and from his door
Slowly departing to return no more,
He rests in holy earth with them that went before.

SAMUEL ROGERS (*b.* 1762).

OUR birth is but a sleep and a forgetting:
The Soul that rises with us, our life's Star,
Hath had elsewhere its setting,
And cometh from afar:
Not in entire forgetfulness,
And not in utter nakedness,
But trailing clouds of glory do we come
From God who is our home:
Heaven lies about us in our infancy!
Shades of the prison-house begin to close
Upon the growing Boy,
But he beholds the light, and whence it flows,
He sees it in his joy;
The Youth, who daily further from the east
Must travel, still is Nature's priest,
And by the vision splendid
Is on his way attended;
At length, the Man perceives it die away,
And fade into the light of common day.
Earth fills her lap with pleasures of her own;
Yearnings she hath in her own natural kind,
And, even with something of a Mother's mind,
And no unworthy aim,
The homely Nurse doth all she can
To make her Foster-child, her Inmate Man,
Forget the glories he hath known,
And that imperial palace whence he came.

WILLIAM WORDSWORTH (*b.* 1770).

BREATHES there the man, with soul so dead,
Who never to himself hath said,
"This is my own, my native land!"
Whose heart hath ne'er within him burned,
As home his footsteps he hath turned,
From wandering on a foreign strand!
If such there breathe, go, mark him well;
For him no minstrel-raptures swell;
High though his titles, proud his name,
Boundless his wealth as wish can claim;

Despite those titles, power, and pelf,
The wretch, concentred all in self,
Living, shall forfeit fair renown,
And, doubly dying, shall go down
To the vile dust, from whence he sprung,
Unwept, unhonoured, and unsung.
O Caledonia! stern and wild,
Meet nurse for a poetic child!
Land of brown heath and shaggy wood,
Land of the mountain and the flood,
Land of my sires! what mortal hand
Can e'er untie the filial band
That knits me to thy rugged strand!

SIR WALTER SCOTT (*b.* 1771).

HAST thou a charm to stay the Morning Star
In his steep course? So long he seems to pause
On thy bald awful head, O sov'reign Blanc!
The Arvé and Arveiron at thy base
Rave ceaselessly; but thou, most awful Form,
Risest from forth thy silent Sea of Pines,
How silently! Around thee and above,
Deep is the air and dark, substantial, black,
An ebon mass: methinks thou piercest it,
As with a wedge! But when I look again,
It is thine own calm home, thy crystal shrine,
Thy habitation from eternity!
O dread and silent Mount! I gazed upon thee,
Till thou, still present to the bodily sense,
Did'st vanish from my thought: entranced in prayer,
I worshipped the Invisible alone.

SAMUEL TAYLOR COLERIDGE (*b.* 1772).

WHO should lament for him within whose heart
Love had no place, nor natural charity?
The parlour spaniel, when she heard his step,
Rose slowly from the hearth, and stole aside
With creeping pace: she never raised her eyes
To woo kind words from him, nor laid her head
Upraised upon his knee, with fondling whine.
How could it be but thus! Arithmetic
Was the sole science he was ever taught;
The multiplication-table was his creed,

His paternoster, and his decalogue.
When yet he was a boy, and should have breathed
The open air and sunshine of the fields,
To give his blood its natural spring and play,
He in a close and dusky counting-house
Smoke-dried, and seared, and shrivelled up his heart.
So, from the way in which he was trained up,
His feet departed not; he toiled and moiled,
Poor muckworm! through his threescore years and ten;
And when the earth shall now be shovelled on him,
If that which served him for a soul were still
Within its husk, 't would still be dirt to dirt.

ROBERT SOUTHEY (*b.* 1774).

HE said, and on the rampart-heights arrayed
His trusty warriors, few, but undismayed;
Firm-paced and slow, a horrid front they form,
Still as the breeze, but dreadful as the storm;
Low, murmuring sounds along their banners fly,
Revenge, or death,—the watchword and reply;
Then pealed the notes, omnipotent to charm,
And the loud tocsin tolled their last alarm!—
   In vain, alas! in vain, ye gallant few!
From rank to rank your volleyed thunder flew:—
Oh! bloodiest picture in the book of Time,
Sarmatia fell, unwept, without a crime;
Found not a generous friend, a pitying foe,
Strength in her arms, nor mercy in her woe!
Dropped from her nerveless grasp the shattered spear,
Closed her bright eye, and curbed her high career;—
Hope, for a season, bade the world farewell,
And Freedom shrieked—as KOSCIUSKO fell!
   Departed spirits of the mighty dead!
Ye that at Marathon and Leuctra bled!
Friends of the world! restore your swords to man,
Fight in his sacred cause and lead the van!
Yet for Sarmatia's tears of blood atone,
And make her arm puissant as your own!
Oh! once again to Freedom's cause return
The patriot TELL—the BRUCE of BANNOCKBURN!

THOMAS CAMPBELL (*b.* 1777).

Now upon Syria's land of roses
Softly the light of eve reposes,

And like a glory, the broad sun
Hangs over sainted Lebanon,
Whose head in wintry grandeur towers,
  And whitens with eternal sleet,
While summer, in a vale of flowers,
  Is sleeping rosy at his feet.
  To one who looked from upper air,
O'er all the enchanted regions there,
How beauteous must have been the glow,
The life, the sparkling from below!
Fair gardens, shining streams, with ranks
Of golden melons on their banks,
More golden where the sun-light falls;—
Gay lizards, glittering on the walls
Of ruined shrines, busy and bright,
As they were all alive with light;—
And, yet more splendid, numerous flocks
Of pigeons settling on the rocks,
With their rich, restless wings, that gleam
Variously in the crimson beam
Of the warm west, as if inlaid
With brilliants from the mine, or made
Of tearless rainbows, such as span
The unclouded skies of Peristan!—
And then, the mingling sounds that come
Of shepherd's ancient reed, with hum
Of the wild bees of Palestine,
  Banqueting through the flowery vales—
And, Jordan, those sweet banks of thine,
  And woods, so full of nightingales!

THOMAS MOORE (*b.* 1779).

I SEE before me the Gladiator lie:
  He leans upon his hand,—his manly brow
Consents to death, but conquers agony,
  And his drooped head sinks gradually low—
  And through his side the last drops, ebbing slow
From the red gash, fall heavy, one by one,
  Like the first of a thunder-shower; and now
The arena swims around him—he is gone,
Ere ceased the inhuman shout which hailed the wretch who won.
He heard it, but he heeded not—his eyes
  Were with his heart, and that was far away;

He recked not of the life he lost nor prize,
But where his rude hut by the Danube lay,
There were his young barbarians all at play,
There was their Dacian mother—he, their sire,
Butchered to make a Roman holiday—
All this rushed with his blood—Shall he expire,
And unavenged?—Arise! ye Goths, and glut your ire!

LORD BYRON (*b.* 1788).

How sweet and solemn, all alone,
With reverent steps, from stone to stone
In a small village churchyard lying,
O'er intervening flowers to move!
And as we read the names unknown
Of young and old to judgment gone,
And hear in the calm air above
Time onwards softly flying,
To meditate, in Christian love,
Upon the dead and dying!
Such is the scene around me now:
A little churchyard on the brow
Of a green pastoral hill;
Its sylvan village sleeps below,
And faintly there is heard the flow
Of Woodburn's summer rill.
What lulling sound, and shadow cool
Hangs half the darkened churchyard o'er,
From thy green depths so beautiful,
Thou gorgeous sycamore!
Oft hath the holy wine and bread
Been blest beneath thy murmuring tent,
Where many a bright and hoary head
Bowed at that awful sacrament.
Now all beneath the turf are laid,
On which they sat, and sang, and prayed.
Above that consecrated tree
Ascends the tapering spire, that seems
To lift the soul up silently
To heaven, with all its dreams,
While in the belfry, deep and low,
From his heaved bosom's purple gleams
The dove's continuous murmurs flow—
A dirge-like song, half bliss, half woe!

JOHN WILSON (*b.* 1788).

LEAVE to the soft Campanian
   His baths and his perfumes;
Leave to the sordid race of Tyre
   Their dyeing vats and looms:
Leave to the sons of Carthage
   The rudder and the oar:
Leave to the Greek his marble Nymphs
   And scrolls of wordy lore.
Thine, Roman, is the pilum:
   Roman, the sword is thine,
The even trench, the bristling mound,
   The legion's ordered line;
And thine the wheels of triumph,
   Which with their laurelled train
Move slowly up the shouting streets
   To Jove's eternal fane.

LORD MACAULAY (*b.* 1800).

RING out wild bells to the wild sky,
   The flying cloud, the frosty light;
   The year is dying in the night;
Ring out, wild bells, and let him die.

Ring out the old, ring in the new,
   Ring, happy bells, across the snow:
   The year is going, let him go;
Ring out the false, ring in the true.

Ring out the grief that saps the mind,
   For those that here we see no more;
   Ring out the feud of rich and poor,
Ring in redress to all mankind.

Ring out old shapes of foul disease;
   Ring out the narrowing lust of gold;
   Ring out the thousand wars of old,
Ring in the thousand years of peace.

Ring in the valiant man and free,
   The larger heart, the kindlier hand;
   Ring out the darkness of the land,
Ring in the CHRIST that is to be.

ALFRED TENNYSON (*b.* 1809).

APPENDIX.

I.—VOCABULARY OF SCIENTIFIC TERMS.[*]

Abdomen. That cavity in the body of a vertebrate animal which contains the organs of digestion. In insects, the hinder section of the body.

Absorption. The process of sucking up fluids or other absorbable substances.

Achromatic. Free from colour; applied to optical instruments which do not decompose light so as to produce colours.

Acid. A term used to designate all substances which combine with bases to form salts. Acids are not in all instances sour to the taste; but they commonly change vegetable blue colours into red.

Acidulous. Slightly acid.

Acoustics. The science of sound.

Actinism. That property of light which effects chemical changes.

Aeriform. Having the form of air.

Affinity. The tendency which certain substances have to unite with each other so as to form new substances. It is also called *Chemical Attraction.*

Aggregate. The whole of a number of particulars in one mass.

Air-pump. A machine for withdrawing and exhausting the air contained in a vessel.

Air-tight. That degree of closeness in any vessel which prevents the passage of air.

Albumen. A whitish substance found in animals and plants, of which the white of egg is an example.

Alkali. A term applied to certain substances—especially potass, soda, and ammonia—which have the property of neutralizing acids. The alkalies have a caustic taste, and change vegetable colours which have been reddened by an acid, into blue.

Alluvial. Carried and deposited by water.

Amalgamation. The compounding of mercury with another metal or metals.

Ammonia. The name of an alkali or base composed of nitrogen and hydrogen. It is called the *volatile* alkali. It is obtained in abundance from putrescent animal substances, and is much used as a manure.

Amorphous. Having no determinate form or shape.

Amphibious. Capable of living both on land and in water.

Analysis. The separation of anything into the elements of which it consists. The opposite of analysis is *Synthesis.*

Anatomist. One who dissects the human body.

Anatomy. The science of the structure of the body, as learned by dissection. The science of the structure of animals generally is called *Comparative Anatomy.*

Angle. The opening between two straight lines which meet in a point. Thus, the opening between the lines EA and AB, which meet in the point A, is the angle EAB. A *right* angle is an angle of 90°. An *obtuse* angle is greater than a right angle; and an *acute* angle less. Thus, CAB is an obtuse angle, DAB a right angle, and EAB an acute angle. The number of degrees is determined by the length of the arc of a circle which bounds the angle, the whole circumference of the circle being divided into 360 equal parts or degrees (°). Every degree is supposed to be subdivided into 60 equal parts, called *minutes* (′); and these again into 60 still more minute parts, termed *seconds* (″).

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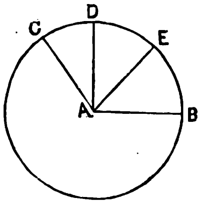
[*] Terms, of which an explanation is given in the Lessons where they occur, are omitted.



Antarctic. Relating to the south pole, or the region near it; applied especially to a circle of latitude 23° 28′ from the south pole.

Antennae. Filaments projecting from the heads of insects and crustacea, and supposed to be feelers or organs of touch.

Antipodes. Those who, living on the other side of the globe, have their feet opposite to ours.

Aorta. The main artery which rises from the left ventricle of the heart, and forms the canal through which the blood passes to all parts of the body.

Apparatus. The means or instruments for effecting a certain end or operation.

Approximation. The process of coming near without absolutely reaching.

Arc. Any part of the circumference.

Arctic. Relating to the north pole, or the region near it; applied especially to a circle of latitude 23° 28′ from the north pole.

Area. The space within any figure; the superficial contents of any figure.

Arteries. The tubes which convey the blood from the heart to all parts of the body. The principal arteries are, the *aorta*, which rises from the left ventricle of the heart, and ramifies through the whole body; and the *pulmonary artery*, which carries the blood from the right ventricle to the lungs. The arteries are distinguished from the veins by pulsation.

Articulation. Connexion by joints; also the distinct utterance of sounds joined together.

Assimilation. The process by which living beings convert other bodies into their own form and substance; as when the food of animals is converted into the substance of their bodies.

Astronomy. The science of the heavenly bodies—the sun, moon, and stars.

Atmosphere. That mass of air which surrounds the earth, and is the common receptacle of its vapours and exhalations.

Atom. A particle of matter incapable of further division.

Atomic Theory. A hypothesis in chemistry which teaches that all chemical combinations take place between the atoms or ultimate particles of bodies, and that these atoms have always a fixed weight.

Attraction. The tendency which bodies have to approach one another. There are various kinds of attraction; as, the attraction of cohesion, the attraction of gravity, chemical attraction, electrical attraction, magnetic attraction.

Auricle. A cavity on each side of the heart resembling the ear of an animal.

Axiom. A self-evident truth, incapable of being made plainer by reasoning or proof; as, "The whole is greater than a part."

Axis. A straight line passing through the centre of a body, on which the body may be conceived to turn.

Azote. A name given to nitrogen gas, on account of its fatal effects upon animal life.

Barometer. An instrument for finding the weight of the atmosphere. It is popularly termed a

Weather-glass, because its variations are believed to prognosticate the approaching state of the weather.

Base, basis. In *chemistry*, any substance which, when combined with an acid, forms a salt.

Binary. Arranged in couples.

Bisect. To divide into two equal parts.

Body. Any determinate portion of matter which may act, or be acted upon, by other portions of matter.

Botany. The science of plants.

Calcareous. Consisting of lime.

Calcine. To reduce to a powdery or friable state by the action of heat; as in the operation of lime-burning.

Calcium. The metallic base of lime.

Calendar. A register or almanac of the year, in which the days of each month are set down in order, with the more remarkable anniversaries.

Calibre. The diameter of a round body; the bore of a gun or other cylindrical tube.

Caloric. The name applied by some chemists to the principle of heat, or that which causes the phenomena of heat.

Calorific. Producing heat.

Camera Obscura. An optical apparatus consisting of a dark chamber into which light is admitted through a double convex glass, so as to fall upon a screen placed in the focus of the glass, thus producing a picture or image of external objects.

Capacity. The power of containing. In *chemistry*, the power of a body to combine with another.

Capsule. A form of seed-vessel, consisting of one or more cells, and splitting into valves.

Carboniferous. Yielding carbon or coal.

Cardia. The orifice or opening in the stomach, which admits the food; it is so named from its proximity to the heart.

Cartilage. An elastic substance intermediate between bone and ligament. It is popularly called *gristle*.

Cartilaginous. Consisting of cartilage; applied also to certain fishes whose skeleton is formed of cartilage instead of bone.

Cell. A minute bag, vesicle, or interstice.

Cellular. Containing cells; applied to the tissues of the body, which are composed of minute cells or interstices, communicating with each other.

Centre. The middle point, that is, the point equally distant from the extremities of a line, figure, or body.

Centrifugal. Having a tendency to fly off from the centre.

Centripetal. Having a tendency towards the centre.

Chemistry. The science of the composition and changes of bodies.

Choke-damp. Carbonic acid gas disengaged in mines.

Chronometer. A watch of a particular construction, which keeps time with such exactness that it enables navigators to calculate the longitude at sea.

Chyle. The milky liquid prepared from the food and absorbed by the lacteal vessels.

Chyme. The pulpy substance into which the food is converted by the process of digestion in the stomach.

Circle. A figure bounded by a curve, every part of which is equidistant from a common centre. The boundary line is called the *circumference*. A straight line passing through the centre and terminated both ways by the circumference, is called the *diameter*. The distance of the centre from the circumference is called the *radius*.

Coal-measures. The strata or layers of the crust of the earth in which coal is found.

Combination. Union of two or more substances so as to form a new compound, in distinction from mere mechanical mixture.

Complement. That which is required to fill up or complete some quantity or thing.

Component. A constituent part or element of a compound body.

Concave. Hollow without angles, opposed to *convex*.

Concentric. Having a common centre.

Condensation. The act of making dense, or causing the particles of a body to approach more closely. The term *compression* is used rather than condensation, when the diminution of bulk is the effect of external force.

Configuration. The shape or outlines of a body.

Conjunction. The moon or a planet is said to be in *conjunction* with the sun when it appears in the same straight line from the earth.

Constellation. A cluster of fixed stars.

Contractile. Having the power of drawing together or shortening.

Converse. When two propositions are opposite reciprocally, the one is said to be the converse of the other.

Convex. Rising or swelling into a rounded form, opposed to *concave*.

Cotyledon. The lobe that nourishes the embryo of plants, and then perishes.

Crucible. A vessel capable of enduring intense heat, and used for melting solid substances.

Crustacea, crustaceous. Applied to certain invertebrate aquatic animals, including the crab, lobster, and shrimp, which have hard jointed crusts or shells.

Crystallization. The process by which the particles of a body, after being parted by fusion or solution, again coalesce and unite in regular or geometrical forms.

Cube. A solid square, that is, a solid body having six equal sides, and each side a square.

Cubic. Having the form of a cube, or capable of being contained in a cube. A *cubic* foot of water is the water that may be contained within a vessel with six equal sides, each a foot square.

Culminate. To gain the meridian or highest point of altitude.

Culmination. The passage of a heavenly body over the meridian; the highest point in the diurnal revolution of a heavenly body.

Curve. A bent line, a line which may be cut by a straight line in more points than one.

Curvilinear. Curve-lined.

Cuticle. The scarf-skin, a membrane covering the *cutis* or true skin.

Cylinder. A solid body of the shape of a roller. Its ends are circular and parallel, and the intermediate portion is convex and circular. A rectangle rotating round one of its sides would produce a cylinder.

Data. Things given or admitted as a foundation for further discovery or deduction.

Decomposition. The resolution of a body into its constituent elements.

Decrement. The quantity lost by gradual diminution.

Deflect. To bend or turn aside from a direct line or course.

Degree. The three hundred and sixtieth part of the circumference of a circle.

Density. Closeness or compactness of particles; the quantity of matter in a body compared with that which is contained in another body of the same bulk or volume.

Deposit. Anything thrown down, as mud from the water in which it has been suspended.

Diagonal. A straight line passing through a four-sided figure from one corner to another.

Diagram. A figure drawn for the purpose of giving a clearer idea of any thing.

Diameter. A straight line passing through the centre of a circle or other curvilinear figure, and terminating at both ends in the circumference.

Diaphragm. The muscular partition which separates the thorax from the abdomen. It is popularly called the *midriff*.

Dip. In *geology*, the inclination of strata to the horizon. In *magnetism*, the inclination of the magnetic needle to the horizon.

Disc, disk. A thin circular plate; the face of the sun, moon, or any planet, as it appears to an observer on the earth.

Dissection. The minute cutting up of an animal to ascertain its structure.

Disintegration. The act of breaking up or separating into integral parts.

Distillation. The process of separating the more volatile part of a compound, by first converting it into vapour by means of heat, and then condensing it by cold.

Eclipse. An interception or obscuration of the light of the sun, moon, or other luminous body. When the moon passes between us and the sun, there is an eclipse of the sun; and when the earth passes between the sun and the moon, there is an eclipse of the moon.

Ecliptic. The great circle of the heavens, which forms the apparent annual path of the sun; so called because eclipses of the sun and moon take place only when the moon is in the same plane with it.

Effervescence. The rapid escape of bubbles of gas through a liquid. Liquids, from which bubbles of gas rapidly escape, are said to effervesce.

Effluvium, effluvia. The minute particles which flow out into the air from substances, as the odour of plants.

Elasticity. That property by which a substance, when compressed, or when forcibly expanded, endeavours, in either case, to resume its former bulk.

Electrization. The act of electrifying or charging with electricity.

Electrometer. An instrument for measuring the intensity of the electricity of a body.

Ellipse, ellipsis. An oval figure, produced by cutting a cone obliquely with a plane. The earth, moon, and planets move in elliptical orbits, the sun being in one of the foci of the ellipse.

Embryo. The rudimentary state of a plant or animal.

Emersion. The reappearance of a heavenly body either after an eclipse, or after being hid by the effulgence of the sun or moon.

Entomology. The science of insects.

Epidermis. The cuticle or scarf-skin; the external layer of the bark in plants.

Equator. The great circle which surrounds the earth at an equal distance from each of the poles.

Equilibrium; in equilibrio. The state of being equally balanced. When two or more forces, acting upon a body, are so opposed to each other that the body remains at rest, there is an *equilibrium*, or the forces are said to be *in equilibrio.*

Equinoctial. The great circle in the heavens, which corresponds to the equator on the earth.

Equinox. The time at which the sun crosses the equator, or, more strictly, when the ecliptic intersects the equinoctial—making the day and the night of equal length. This happens at the vernal equinox, or about the 21st of March, when the sun passes northward, and again on his return southward at the autumnal equinox, or about the 23d of September.

Ether. An imaginary fluid supposed by some to fill all space beyond the atmosphere of the earth and of the planets.

Etiolation. The process of blanching or whitening by the exclusion of light.

Evaporate. To pass off in vapour; to convert into vapour.

Explosion. The sudden expansion of an elastic fluid with force and a loud report.

Fermentation. A peculiar change in organic substances, by which their elements are rearranged, and new products generated. Fermentation is called *vinous*, when it terminates in the production of alcohol; and *acetous*, when vinegar is the product.

Fibre. A fine slender thread-like substance, entering into the structure of plants and animals.

Filament. Any thread-like substance.

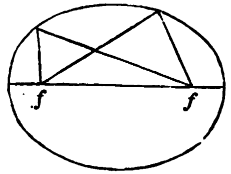
Filtration. The process of filtering, that is, of straining a liquid through some porous substance in order to clear it from lees or foulness.

Fluids. Substances in which the particles are so slightly cohesive that they are movable in every direction, and pass over one another with the least impulse. Fluids are of two classes—*liquid* and *gaseous*.

Fluidity. The state of being fluid.

Focal Distance. The distance between the centre of a lens or mirror and the point where the rays of light are collected.

Focus, foci. The point in which rays meet, as the focus of a burning glass. The *foci* of an ellipse are two points in the transverse diameter, equally distant from its ends, and so situated, that, if we take any point in the circumference of the ellipse and draw lines from that point to the two foci, the length of these lines, when joined together, will always be the same, at whatever part of the circumference the point may be taken.



Force. That which causes an operation or effect.

Formation. An assemblage of rocks or rocky strata, formed at the same epoch, and characterized by organic or mineral affinities.

Fossils. Mineralized remains of plants or animals; called also *Organic remains*.

Fossiliferous. Containing fossils.

Fraction. A broken part of an entire number or quantity.

Friable. Easily crumbled.

Friction. The rubbing or grating of the surfaces of bodies one upon another.

Fulcrum. The prop or pivot on which a lever turns.

Fulgurite. A vitrified sand-tube, formed by the action of lightning.

Function. The office or use of any particular part or organ of a plant or animal.

Fungus. One of the *fungi*, an order of flowerless plants of which the mushroom is the type; an excrescence growing on a plant or animal.

Fusible. Capable of being liquefied by heat.

Fusion. The act or state of being liquefied or melted.

Galaxy. A luminous track in the heavens, composed of a dense assemblage of stars; popularly called *the Milky Way*.

Gas. The name given to any permanent aeriform fluid. Gases are called *elastic* fluids, to distinguish them from liquids, which, having but little elasticity, are named *non-elastic*. Gases retain their elasticity in all temperatures, and in this they differ from *vapours*, which, being only liquids rarefied by heat, return to the liquid state when the temperature is diminished.

Gaseous. In the form of gas.

Gastric. Belonging to the stomach.

Genus (*pl.* genera). An assemblage of species possessing certain common distinctive characters.

Geography. The science of the earth's surface.

Geology. The science of the interior structure of the earth.

Geometry. The science of extension.

Germination. The act of sprouting; the first beginning of vegetation in a seed or plant.

Gibbous. Rounded like a hump; applied to the shape of the moon in her second and third quarters.

Glacier. A field of snow and ice, formed in the higher valleys of mountains, such as the Alps, and gradually sliding down into the lower valleys.

Gland. An organ in plants or in animals for secreting or separating some peculiar material.

Globule. A small particle of matter of a spherical or globular form.

Glutinous. Having the quality of gluten or glue.

Gneiss. A hard tough crystalline rock, composed chiefly of quartz, felspar, and mica, and differing from granite in having its crystals so disposed as to give it a slaty appearance.

Graduate. To mark with degrees or regular divisions, as in the case of a thermometer.

Graduation. The act or process of marking instruments with degrees.

Granite. A hard crystalline rock of a granular texture, composed chiefly of quartz, felspar, and mica. It is of various colours, according to the proportions of its component parts.

Granitic. Pertaining to granite, or consisting of granite.

Granular. Consisting of grains, or resembling grains.

Graphite. Blacklead, a mineral composed of carbon.

Gravity, gravitation. A name given to the tendency which bodies have to fall to the earth, or rather towards the centre of the earth.

Gravity, Specific. The weight of any body as compared with the weight of an equal bulk of water taken as unity. Thus, a cubic inch of platina is about 21 times the weight of a cubic inch of water, while a cubic inch of silver is 10 times the weight of a cubic inch of water. Hence, the specific gravity of platina is said to be 21, and that of silver 10.

Gregorian Telescope. The first and most common form of reflecting telescope, invented by James Gregory, an eminent mathematician, born at Aberdeen in 1638.

Gutta Percha. The gum of a forest-tree in Borneo, which, when reduced to a pulp and mixed with other substances, is of great use in the arts.

Gyration. The action of turning round a centre, in the manner of a wheel.

Habitat. The natural site or abode of a plant or animal.

Halo. A luminous and sometimes coloured circle, appearing occasionally around the sun and moon.

Hebetation. The act of dulling or blunting; the state of being dulled or blunted.

Hermetically sealed. A tube is said to have the seal of Hermes, or to be hermetically sealed, when the neck is heated to the melting point, and then twisted with pincers till it be air-tight.

Heterogeneous. Consisting of elements of different nature.

Homogeneous. Consisting of elements of like nature.

Horizon. The circle which bounds the view when the eye is carried round in a level direction; or, in other words, the circle in which the apparent plane of the earth terminates in the concave of the sky. This is called the *sensible horizon*, to distinguish it from the *true* or *astronomical horizon*, which is parallel to the *sensible*, but is conceived to be a plane passing through the centre of the earth, and dividing the whole celestial sphere into the upper and lower hemispheres.

Horizontal. In the plane of the horizon, or parallel to the horizon.

Hydraulic. Relating to the conveyance of water through pipes.

Hydrometer. An instrument for measuring the specific gravity of fluids.

Hydrostatic. Relating to the pressure of fluids at rest.

Hydrostatics. The science of fluids at rest.

Hygrometer. An instrument for measuring the amount of moisture in the atmosphere.

Hypothesis. A conjecture or theory laid down at the outset of an inquiry, in the expectation that future experiments will verify it.

Ignition. A setting on fire; the state of being kindled.

Immersion. In *astronomy*, the entrance of one celestial body into the light or into the shadow of another, so as to become invisible.

Impact. The action of two bodies on each other in coming together.

Inclination. The direction of one body with respect to another, as measured by the angle formed at the point where the bodies meet.

Indigenous. Native to a country or region.

Induction. The collecting of a multitude of facts or observations on any particular subject, and drawing general conclusions from a survey of the whole. It is the opposite of *Hypothesis*. In *electricity*, the process by which an *insulated* electrified body produces an opposite electric state in neighbouring bodies.

Inertia: vis inertiae. The property by which matter resists a change in its present state whether of motion or of rest.

Infusion. The process of steeping substances in a liquid, so as to extract certain qualities from them; the liquor thus prepared.

Inorganic. Not having organs or the organized structure characteristic of living existences.

Insulation. The state of being detached or isolated.

Integer. The whole; applied to a whole number as distinguished from a fraction.

Integrant. Making part of a whole; applied only when the part is of the same nature as the whole.

Intersect. To cut or cross mutually.

Interstice. A small intervening space.

Intestines. The alimentary canal or bowels. The length of the intestines in the human being is upwards of 30 feet; and from the difference of the diameter of different parts, they are distinguished into two portions,—the *smaller intestines*, viz. the *duodenum*, the *jejunum*, the *ilium*, which form the upper part of the tube and four-fifths of the whole; and the *large intestines* — the *cæcum*, *colon*, and *rectum*—which constitute the remaining part.

Inverse ratio. If two magnitudes are such, that, when the one increases, the other decreases, the ratio or proportion between them is said to be *inverse*. Thus, the ratio of the length of the day to the length of the night is an *inverse* ratio; for in proportion as the length of either *increases*, that of the other *diminishes*.

Invertebrate. Having no vertebrae or spinal bones.

Iris. The coloured circle which surrounds the pupil of the eye.

Laboratory. A place furnished with the necessary apparatus for the performance of experiments.

Lacteals. The absorbent vessels which take up the chyle from the alimentary canal, and convey it to the thoracic duct, where it is mixed with the blood.

Larynx. The upper and protuberant part of the trachea or windpipe; commonly called *Adam's apple*.

Latitude. The distance of a place on the globe, north or south of the equator.

Lava. The general name for molten matter discharged from a volcano.

Lens. A piece of glass or other transparent substance, with two curved surfaces, or with a curved and a plane surface, used for the purpose of changing the direction of the rays of light which pass through it.

Lever. A bar turning on a fulcrum or axis, used for raising weights.

Liber. The inner layer of the bark of a tree.

Libration. The act of balancing; the state of being balanced.

Lichens. Rock-moss and tree-moss, an order of plants which cover rocks and trees. The lichens include the Iceland moss, the reindeer moss, and several species of liverwort, but they are quite distinct from the *musci*, or true mosses.

Ligament. A strong fibrous membrane connecting the bones or articulations of the animal body.

Limb. The outer edge or border of the sun or moon.

Line. That which has length, but no breadth; the tenth part of an inch. A *right* line means a straight line, the shortest line that can be drawn between two points.

Lineal, Linear. Consisting of lines, or relating to length.

Liquefy. To melt by heat.

Liquids. Fluids whose elasticity is inactive, and whose cohesion is so much less than their gravity, that they separate by their own weight, and are easily divisible into drops. The liquid is the middle state between the solid and the gaseous.

Lobe. A part or division of an organ, as of the lungs or brain.

Locomotion. Motion from place to place.

Locomotive. Moving from place to place; the steam-engine which moves a railway train.

Longitude. The distance of a place on the globe, east or west of a given meridian on the earth's surface. The ancients supposed the earth to be a narrow plain extending from east to west; and hence from east to west they called *longitude*, and from north to south *latitude*. These terms are still retained, though it is now known that the earth is spherical.

Lungs. The organs of respiration in man and some other animals. They consist of branching air-tubes and interlacing blood-vessels, interwoven into a spongy substance; and their specific purpose is to bring air and blood into close and free communication. There are two lungs, one in each cavity of the thorax.

Magnetism. The science of the magnetic force.

Magnetization. The act of magnetizing or imparting magnetic properties.

Mammalia. A name given to those vertebrate animals which suckle their young.

Manipulate. To operate upon with the hands.

Mastication. The act of chewing food and mixing it with saliva.

Mathematics. The science of number and quantity.

Material. Consisting of matter—opposed to *spiritual* or *mental*.

Matter. The substance of which all bodies having extension are composed—opposed to *mind* or *spirit*.

Maximum. The greatest quantity or effect attainable under the circumstances.

Mechanics. The science of motion and moving powers.

Medium. Anything intervening, through which a body must pass to reach another body not in contact with it.

Membrane. A flexible substance, consisting of a net-work of fibres, and serving to cover some part of an animal or vegetable body.

Membranous. Consisting of membranes.

Meridian. A great circle drawn through the poles of the earth at right angles to the equator. Every place on the globe has its meridian; and when the sun arrives at this circle, it is mid-day or noon at the place. The *first meridian* is that from which longitude is reckoned; in this country it is that which passes through the Observatory at Greenwich, near London.

Mesenteric. Pertaining to the mesentery, the membrane by which the intestines are supended.

Meteor. Any atmospheric phenomenon of a transitory nature; more particularly, a fiery or luminous body appearing suddenly and moving rapidly in the atmosphere.

Meteorology. The science of atmospherical phenomena, particularly in their relation to heat, moisture, and electricity.

Miasma, miasmata. Noxious effluvia floating in the air.

Mica. A scaly glistening mineral, composed chiefly of silica, potash, and magnesia. From it granite derives its glistening scaly appearance.

Microscope. An optical instrument, formed of lenses which magnify objects placed in their focus.

Milky Way. The galaxy,—a track in the heavens, so crowded with fixed stars as to give the space they occupy a white shiny appearance.

Mineralogy. The science of mineral or inorganic substances.

Minimum. The smallest quantity

or effect attainable under the circumstances—opposed to *maximum*.

Mobile. Capable of being easily moved.

Molecule. A minute particle of a body. *Molecules* differ from *atoms* in this, that they are never considered but as portions of some aggregate.

Mollusca, molluscs. A group of invertebrate animals, such as the snail and the oyster, so called from the softness of their bodies.

Momentum. The impetus or force of a body in motion; in other words, the force of percussion. It is the product of the quantity of matter and the velocity.

Motor. Imparting or regulating motion; applied to certain nerves.

Mucus. The slimy fluid which covers the lining of the nose, the lungs, and other cavities of the body, which open externally. The membrane which secretes mucus and lines the inner surface of the body, is called the *mucous membrane.*

Multiple. A number containing another number several times without any remainder. Thus, 12 is a multiple of 3.

Muriatic acid. Another name for *hydrochloric acid*, or spirit of salt.

Muscle. An animal tissue composed of bundles of soft fibres, and endowed with the power of contraction and dilatation. The muscles are the organs by which the movements of the body are effected, and for this purpose their ends are fastened to the bones and tendons which they move. Muscles are divided into *voluntary* and *involuntary* muscles—the former being subject to the will, the latter acting independently of the will.

Nadir. The point in the heavens diametrically opposite to the Zenith. The Zenith and Nadir are the two poles of the horizon.

Narcotic. Producing drowsiness and insensibility to pain.

Natural History. The science of the Three Kingdoms of Nature, including mineralogy, geology, botany, and zoology.

Nebula, nebulae. A cluster of stars, which seems only a luminous mist when viewed with a telescope of ordinary power.

Nerve. The nerves are those white fibrous cords which proceed from the brain and spinal marrow to all parts of the frame, and form the organs of sensation and motion.

Nervous System. That collection of organs, comprising the brain, the spinal cord, and the nerves, whose office is to receive and convey impressions and volitions.

Nodes. The points in the orbit of the moon, or of a planet, at which the moon or the planet crosses the ecliptic.

Nomenclature. The names or technical terms proper to a particular branch of science.

Normal. Regular, or according to rule. *Abnormal*, irregular.

Nucleus. Anything around which matter is gathered or conglomerated.

Nutrition. The process by which living bodies have their waste repaired and their growth promoted.

Octant. The eighth part of a circle, or 45 degrees.

Oesophagus. The gullet, the tube or canal which conveys the food from the mouth to the stomach.

Oolite. A variety of limestone, composed of small rounded particles resembling the eggs or roe of a fish; also the name given by geologists to a system of stratified rocks containing oolitic limestone.

Opacity. The quality of being opaque, or impervious to light.

Opposition. The moon or a planet is said to be in *opposition* to the sun when the earth is in a direct line between it and the sun. It is the opposite of *conjunction.*

Operation. The process of carrying on any work, or the work itself.

Optics. The science of light and vision.

Orbit. The curvilinear path which

a heavenly body takes in going round the central body.

Order. In *natural history*, a group of genera. Plants and animals are sometimes arranged thus, *classes*, *orders*, *genera*, and *species*. A *class* comprises various *orders;* an *order* is divided into *genera*, and a *genus* into *species*.

Organ. A natural instrument by which some process or function in plants and animals is carried on, as the eye, the ear, the lungs, etc.

Organic. Having organs, or relating to bodies which have organs.

Organism. The assemblage of organs constituting a body.

Organize. To form with suitable organs, so that the whole may work together in a body.

Orifice. An opening or perforation.

Orrery. A machine for exhibiting the motions and phases of the earth, moon, and planets.

Oscillation. A swinging backwards and forwards; applied particularly to the motion of a pendulum.

Oxidate, oxidize. To convert into an oxide.

Oxide. A body formed by the combination of a metal or other elementary substance with oxygen.

Oxygenate, oxygenize. To mix or combine with oxygen.

Palaeozoic. Containing the oldest remains of animal life; applied to the lowest system of rocks which contains fossils.

Pancreas. The sweetbread, a flat narrow gland between the liver and the spleen, which secretes a fluid called the *pancreatic juice.*

Papilla. A small conical projection of the skin or mucus membrane, usually containing a larger supply of blood-vessels and nerves than the adjoining surface.

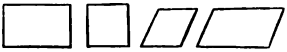
Pappus. The seed-down.

Parabola. The curve produced when a cone is cut by a plane parallel to one of its sides. The curve described by a projectile, as a stone thrown by the hand, or a ball shot from a gun, is a parabola.

Paradox. A proposition in appearance absurd, yet true in fact.

Parallel. Extending in the same direction and always equidistant; applied to lines in the same plane which being produced ever so far both ways do not meet.

Parallelogram. A four-sided rectilinear figure, whose opposite sides are parallel. When its angles are right angles, it is usually called a *rectangle* or *oblong*. If all its sides, as well as angles, are equal, it is a *square*. When its sides are equal, but its angles unequal, it is called a *rhombus;* and if the opposite sides only are equal, it is called a *rhomboid* or *rhomboides*.



Pencil of light. A cone of rays, diverging from some point, or converging to some point.

Pendulum. A body suspended so that it may swing backwards and forwards by the action of gravity.

Perimeter. The bounding line of any plane figure.

Periphery. The bounding line of any curvilinear figure.

Peristaltic. Spiral; applied to the worm-like motion which takes place in the intestines from the contraction of their muscular coats.

Perpendicular. A line falling at right angles on another line; a line falling at right angles to the plane of the horizon, or in the direction of the centre of the earth —as, for example, a plumb-line, or the pendulum of a clock when at rest.

Perspective. The art of drawing distant and near objects on a plane surface, so that they appear to have their relative places and distances.

Pharynx. The muscular bag or tube at the back part of the mouth, which forms the top of the oesophagus.

Phase, phasis, phases. Appearance exhibited by any body; applied to the various appearances which the moon or a planet presents in the course of its revolution.

Phenomenon, phenomena. Any appearance or appearances in nature, whose cause, not being obvious, requires to be investigated.

Photography. The process of producing representations of objects by the chemical action of light on a prepared surface.

Physical. Pertaining to natural or material things, as opposed to *moral* and *spiritual*.

Piston. A small block of wood or metal, so fitted to the bore of a cylinder as to move freely up and down within it, yet air-tight. The piston, with its piston-rod, is a necessary part of the apparatus of a pump. It serves the purpose of exhausting the air from the tube, and is hence called the *Sucker*.

Plane. A level surface, such that a straight line drawn between any two points of it will always coincide with it.

Plastic. Endowed with formative power,—that is, power to give shape and fashion to a thing.

Poles. The extremities of the axis of a sphere, as the poles of the earth; also the extremities of a magnet.

Power. That which is capable of effecting a change in the state of a body. When power is exerted it is *force:* power is latent force.

Precipitate. To cause a substance previously held in solution to fall to the bottom; the sediment thus caused.

Pressure. Force in continued contact with the body upon which it is exerted.

Prism. A solid figure, the two ends of which are parallel, and the sides parallelograms. The prism of glass used in optical experiments is triangular; that is, its two ends are triangles, and its other faces are three parallelograms.

Prismatic spectrum. The various coloured appearance which a ray of white light exhibits after passing through a glass prism.

Problem. A question proposed for solution.

Process. A proceeding or operation.

Projectile. A body projected by force, especially through the air.

Proximate. Nearest. A *proximate* cause is that which immediately precedes the effect, as distinguished from a *remote* or *ultimate* cause. The *proximate principles* of organized bodies are those compounds which exist ready formed in animals and plants, as albumen, gelatin, sugar, starch.

Putrefaction. A spontaneous fermentation, by which animal and vegetable bodies are disorganized and reduced to their original elements. In the case of animals, this process is attended by fetid and noxious exhalations, which, however, may, for the most part, be rendered innocuous by the agency of chlorine — a powerful disinfectant.

Pylorus. The lower orifice of the stomach, through which the food passes into the intestines.

Pyramid. A solid having any plane figure for its base, and for its sides triangles which all terminate in a point at the top called the vertex.

Quadrature. The moon is said to be in *quadrature* when the line from the earth to the sun, and the line from the earth to the moon, form an angle of 90°. When in quadrature, the moon is at an equal distance from the points of conjunction and opposition.

Quartz. Crystallized silica or rock-crystal.

Quinine. A vegetable alkali contained in Peruvian bark, and extensively used as a tonic and a febrifuge.

Radiata. A group of invertebrate animals, characterized by having the parts of the body arranged round a centre or axis; as the star-fish.

Radiation. The sending out of light or heat, in all directions, like rays, from a body.

Radius (*pl.* radii). Any straight line from the centre to the circumference of a circle; called also *semi-diameter*.

Rain-gauge. An instrument for measuring the quantity of rain which falls at any place.

Ramification. The process of branching or shooting out branches; a division or subdivision resembling branches.

Ratio. Proportion.

Reaction. The resistance made by a body to the action or impulse of another body.

Rectangle. A right-angled parallelogram.

Rectilineal, rectilinear. Straight-lined.

Reflection. The rebound of rays of light or heat from a body against which they have struck.

Reflector. A polished surface of metal or other material used for the purpose of throwing back rays of light or heat.

Refraction. The change of direction undergone by a ray of light in passing from one medium into another of a different density.

Refrangibility. The capacity of being refracted or bent from a direct course; the degree of that capacity possessed by the several threads of a ray of light.

Repulsion. The power or principle in bodies or in the particles of bodies, by which, under certain circumstances, they refuse to meet one another. It is the opposite of *attraction*.

Resinous. Consisting of resin, or having the properties of resin.

Resistance. The quality of withstanding any power or force so as to destroy or diminish its effect.

Respiration. The act of breathing, that is, of inhaling air into the lungs, and again exhaling or expelling it. It is strictly two acts, — *inspiration*, which generally takes place about twenty-six times in a minute, thirteen cubic inches of air being inspired each time; and *expiration*, which takes place alternately with the preceding act.

Retardation. The lessening of the velocity of a moving body. The opposite term is *acceleration*.

Retina. The hinder coat or tunicle of the eye, resembling a fine network, and consisting of an expansion of the optic nerve.

Retort. A globular vessel with a long neck, used in distillation; called by the older chemists an *alembic*.

Revolution. The movement of a body round a fixed point or centre.

Rhomb, rhombus. A four-sided rectilineal figure, with equal sides, but unequal angles. It is a square pressed out of shape until it assumes the form of the diamond in a pack of cards.

Rhomboid, rhomboides. An elongated rhombus.

Rotation. The turning of a body on its axis.

Rotatory. Turning on an axis.

Safety-lamp. A lamp surrounded by fine wire-gauze, to give light in mines, without igniting the inflammable gases generated there.

Safety-valve. A valve fitted to the boilers of steam-engines, in order to diminish the risk of explosion, by permitting the escape of the steam before the expansive power is so high as to burst the boiler. It opens outwardly, and is loaded with a weight sufficient to withstand a certain pressure of steam; but it is forced open whenever the pressure exceeds this maximum.

Saline. Containing salt, or having the properties of salt.

Saliva. Spittle; the fluid secreted by certain glands in the mouth, called the salivary glands.

Salt. In *chemistry*, the name given to any substance resulting from the combination of an acid and a base.

Satellite. A moon or secondary planet revolving round another planet.

Saturate. To supply or fill up until no more can be received or imbibed.

Section. A cutting or portion of anything.

Secrete. To separate some substance from the blood of an animal or from the sap of a plant.

Secretion. The separation of some substance from the blood or the sap; the substance so separated.

Segment. A part cut off from a circle or from a sphere.

Sensation. The conscious feeling or perception of external objects.

Senses. The faculties or powers by which external objects are felt or perceived. The senses are five in number, — sight, hearing, smell, taste, and touch.

Sensible. Capable of sensation; perceptible by the senses.

Sensorium, sensory. The brain, the seat and organ of sensation.

Sentient. Capable of sensation.

Shellac. A resinous substance prepared from the resin of the banyan-tree.

Siliceous. Containing silex or flint; of a flinty texture.

Silurian. Applied to a system of rocks which is found largely developed in South Wales, the country of the ancient *Silures*.

Siphon, syphon. A bent tube with legs of unequal length, used for drawing liquid from a vessel without disturbing the sediment that may be at the bottom.

Sirius. The large bright star commonly called the Dogstar.

Solid. A body whose particles are so close and cohesive, that it is movable only as a combined mass.

Soluble. Capable of being dissolved in a fluid.

Solution. The state of being dissolved; also applied to a fluid containing another substance dissolved in it. When a fluid will dissolve no more of the substance, but allows the excess to fall to the bottom of the vessel, it is said to be *saturated*, and the mixed fluid is then a *saturated solution* of the substance which it contains.

Solvent. Any body which has the power of dissolving another body. It is also termed a *menstruum*.

Species. In *zoology* and *botany*, a group of individuals which proceed from a common stock, and transmit, by propagation, the same essential nature and qualities. A species may include many *varieties*.

Specific. Not general, but confined to an *individual* or a *species*.

Sphere. A round body like a ball.

Spheroid. A solid approaching a sphere in form, but not perfectly globular. There are two forms of the spheroid,—the *oblate*, shaped like an orange, and the *oblong*, shaped like a lemon. The earth is an oblate spheroid, being flattened at the poles.

Spinal Cord or Marrow. The part of the nervous system which is contained in the canal of the vertebral column or spine.

Spiral. Winding round a fixed point or centre, and at the same time constantly receding from it; as the mainspring of a watch.

Spleen. The milt. A soft organ near the top of the abdomen in animals.

Spongiole. The loose cellular tissue at the extremities of roots, which has the property of absorbing fluid like a sponge.

Spore, sporule. That part of flowerless plants which corresponds to the seed in flowering plants.

Square. A rectilineal figure having four equal sides and four right angles.

Steam. Water in an elastic form, and at or above the temperature of the boiling point.

Stratification. The process by which substances are formed into strata or layers; state of being arranged in layers.

Stratum, strata. A bed or mass of matter spread out over a certain surface; as a layer of sand and gravel at the bottom of a river.

Structure. The manner of organization in animals and plants; the particular arrangement of the integrant molecules in minerals.

Subclavian. Lying under the clavicle or collar-bone.

Succulent. Juicy; applied to plants with soft juicy stem and leaves.

Superincumbent. Resting or lying on something else; applied to the position of stratified rocks.

Suspended, suspension. A substance is said to be *suspended*, or held *in suspension* in a fluid when, instead of being *in solution*, it is only so intermixed with the fluid as to be separable by filtration.

Synthesis. The putting together of the elements of which anything consists—opposed to *analysis*.

System. An assemblage of things

so arranged and adjusted as to constitute a consistent and symmetrical whole.

Tangent. A straight line touching a curve, but not cutting it.

Technical. Belonging exclusively or strictly to some art or science.

Telegraph. An instrument for communicating messages to a distance.

Telescope. An optical instrument formed of lenses which magnify distant objects.

Temperature. The comparative degree of heat in a body.

Tendon. A fibrous cord or ligature attached to a muscle; a sinew.

Tension. The act of stretching or straining, or the state of being stretched or strained.

Terminal. Pertaining to, or placed at, the end of an object.

Terminus. A boundary; the extreme point or station at either end of a railway.

Theory. A philosophical explanation of phenomena.

Thermometer. An instrument for measuring the heat or temperature of a body.

Thoracic. Pertaining to the thorax or chest. *Thoracic duct*, the canal which conveys the contents of the lacteals into the blood.

Thorax. The chest; in insects, the second segment of the body.

Tissue. The minute elementary fabrics of which the organs of animals and plants are composed.

Transit. A passing; specially, the passage of a planet over the sun's disc; also the culmination of a heavenly body—that is, its passage across the meridian.

Transparency. That property of a body which allows light to pass through it: the opposite of *opacity*.

Triangle. A plane figure having three sides and three angles,—called also a *trigon*.

Tropics. A name applied to the two imaginary circles lying parallel to the equator at the distance of 23½° north and south. The northern circle is called the *Tropic of Cancer*, and the southern, the *Tropic of Capricorn*. These circles form the boundaries of the *Torrid Zone*.

Tropical. Within the tropics, or pertaining to the tropics.

Tube. Any body long and hollow like a pipe.

Tunicle. Any natural coat or integument.

Type. The perfect normal representation or idea of anything.

Ultimate. That to which as the final object all that precedes is directed; the last into which a substance can be resolved.

Undulation. A motion like that of waves.

Universe. The whole system of created things.

Vacuum. A space void of matter; generally used to denote the interior of a close vessel from which the air has been extracted. The vacuum produced in a vessel by means of an air-pump is never perfect; yet the vessel is termed an *Exhausted Receiver*. *In vacuo*, in a void or vacuum.

Valve. A close lid affixed to a tube by means of a hinge or other movable joint, and opening only in one direction.

Vapour. Any liquid expanded into an elastic or aeriform fluid.

Variety. A plant or animal differing from the rest of the species to which it belongs in certain things produced by climate or culture, and not permanently transmitted.

Veins. Those elastic tubes which receive the blood after it has been circulated by the arteries, and convey it back to the heart.

Velocity. The comparative celerity of motion in a moving body.

Ventricles. The name given to the two cavities of the heart which propel the blood into the arteries.

Vertebra (*pl.* vertebrae). A division or separate bone of the spine or spinal column.

Vertebrata. Animals having a spine; comprising, Mammalia, Birds, Amphibia, and Fishes.

Vertebrate. Having a vertebral column, that is, a spine composed of a number of bones jointed together.

Vertical. Perpendicular to the plane of the horizon; the opposite of horizontal.

Vesicle. Any small membranous cavity in plants or animals.

Vesicular. Consisting of vesicles.

Vibration. The swinging motion of a suspended body, as a pendulum; the tremulous motion produced in a body when struck.

Vision. The power or the act of seeing.

Vitreous. Pertaining to, or consisting of, glass; resembling glass.

Volatile. Capable of easily passing into an aeriform state.

Voltaic Battery. An apparatus for the development of Voltaic electricity, consisting of a series of plates of zinc and copper immersed in an acid fluid.

Voltaic Electricity. The electrical action produced by the *Voltaic Battery*. It was originally named *Galvanism*, after its discoverer, Professor Galvani of Bologna; but it is now named *Voltaism*, after Professor Volta of Pavia, who first correctly described it.

Volume. The apparent space which a body occupies. The real space which it occupies, or its actual bulk of matter, is called its *mass*. The volume and the mass vary according to the density of the body.

Zenith. The point in the arch of the heavens which is vertical to the spectator; the opposite of *nadir*.

Zero. A cipher; the point of a thermometer from which it is graduated. In Fahrenheit's thermometer, zero is 32° below the freezing point of water.

Zoology. The science or natural history of the animal kingdom.

Zoophyte. A name given to animals which are fixed to the ground and have the form of plants.

II.—PREFIXES, AFFIXES, AND PRINCIPAL LATIN AND GREEK ROOTS OF THE ENGLISH LANGUAGE.*

(*To be committed to Memory.*)

I. PREFIXES.

1. OF ENGLISH OR SAXON ORIGIN.

A, *on* or *in*, as *a*-foot, *a*-bed.

Be, *about*, as *be*sprinkle; also *for* or *before*, as *be*speak.

En, *in* or *on*, as *en*circle; also *make*, as *en*feeble. (*En* is changed into *em* in roots beginning with *b* or *p*, as *em*bark, *em*power.)

Fore, *before*, as *fore*see.

Mis, *wrong* or *defect*, as *mis*deed.

Out, *excess* or *superiority*, as *out*run.

Over, *eminence* or *excess*, as *over*charge.

Un, before an adjective or adverb, signifies *not*, as *un*worthy; un, before a verb, generally signifies the *undoing* of the act expressed by the verb, as *un*fetter. (*Un* is sometimes prefixed to a verb without altering the sense, as *loose*, *unloose*.)

Up, *motion upwards*, as *up*start; also *subversion*, as *up*set.

With, *from* or *against*, as *with*draw, *with*stand.

2. OF LATIN ORIGIN.

A, ab, abs, *from* or *away*, as *a*vert, *ab*solve, *abs*tain.

Ad, *to*, as *ad*here. (*Ad* assumes the various forms of *a*, *ac*, *af*, *ag*, *al*, *an*, *ap*, *ar*, *as*, *at*, according to the commencing letter of the root with which it is joined, as *as*cend, *ac*cedo, *af*fix, *ag*grandize, *al*lot, *an*nex, *ap*peal, *ar*rest, *as*sume, *at*tract.)

Am, *round about*, as *am*bient.

Ante, *before*, as *ante*cedent.

Circum, *round* or *about*, as *circum*navigate. (*Circum* also takes the form *circu*, as *circu*it.)

Cis, *on this side*, as *cis*alpine.

Con, *together*, as *con*voke. (*Con* takes also the various forms of *co*, *cog*, *col*, *com*, *cor*, as *co*-operate, *cog*nate, *col*lect, *com*motion, *cor*relative.)

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* Those who are desirous to acquire further information on this important subject may consult the Author's *Manual of English Grammar*.

Contra, *against*, as *contra*dict. (*Contra* sometimes takes the form *counter*, as *counter*balance.)

De, *down*, as *de*jected.

Dis, *asunder*, as *dis*tract, also *negation* or *undoing*, as *dis*arm. (*Dis* has also the forms of *di* and *dif*, as *di*verge, *dif*fuse.)

E, ex, *out of*, as *e*gress, *ex*clude. (*E*, *ex*, take also the form of *ec*, *ef*, as *ec*centric, *ef*flux.)

Extra, *beyond*, as *extra*ordinary.

In, before an adjective, signifies *not*, as *in*active; *in*, before a verb, signifies *in* or *into*, as *in*ject. (*In* has also the various forms of *ig*, *il*, *im*, *ir*, as *ig*noble, *il*luminate, *im*port, *irra*diate.)

Inter, *between*, as *inter*vene.

Intro, *to*, *within*, as *intro*duce.

Juxta, *nigh to*, as *juxta*position.

Ob, *in the way of*, or *opposition*, as *ob*stacle. (*Ob* has also the various forms of *oc*, *of*, *o*, *op*, *os*, as *oc*cur, *of*fend, *o*mit, *op*pose, *os*tentation.)

Per, *through* or *thoroughly*, as *per*forate, *per*fect. (*Per* has also the form of *pel*, as *pel*lucid.)

Post, *after*, as *post*diluvian.

Pre or præ, *before*, as *pre*dict.

Preter or præter, *past* or *beyond*, as *preter*natural.

Pro, *for*, *forth*, or *forward*, as *pro*noun, *pro*voke, *pro*ceed.

Re, *back* or *again*, as *re*tract, *re*build.

Retro, *backwards*, as *retro*spect.

Se, *aside* or *apart*, as *se*cede.

Sine, *without*, as *sine*cure. (*Sine* has also the form of *sim* and *sin*, as *sim*ple, *sin*cere.)

Sub, *under* or *after*, as *sub*side. (*Sub* has also the forms of *suc*, *suf*, *sug*, *sup*, *sus* (contracted for *subs*), as *suc*ceed, *suf*fuse, *sug*gest, *sup*press, *sus*pend.)

Subter, *under* or *beneath*, as *subter*fuge.

Super, *above* or *over*, as *super*fluous. (*Super* has also the French form *sur*, as *sur*mount.)

Trans, *over from one place to another*, as *trans*port.

Ultra, *beyond*, as *ultra*mundane.

3. OF GREEK ORIGIN.

A or an, *without* or *privation*, as *a*pathy, *an*onymous.

Amphi, *both* or *the two*, as *amphi*bious.

Ana, *through* or *up*, as *ana*tomy.

Anti, *against*, as *Anti*christ. (*Anti* has sometimes the contracted form of *ant*, as *ant*arctic.)

Apo, *from* or *away*, as *apo*stasy. (*Apo* has sometimes the contracted form of *ap*, as *ap*helion.)

Cata, *down*, as *cata*rrh. (*Cata* has also the form of *cat*, as *cat*echise.)

Dia, *through*, as *dia*phanous.

Epi, *upon*, as *epi*taph. (*Epi* has also the form of *ep*, as *ep*hemeral.)

Hyper, *over and above*, as *hyper*critical.

Hypo, *under*, as *hypo*thesis.

Meta, *change*, as *meta*morphosis. (*Meta* has also the form of *met*, as *met*hod.)

Para, *near to*, or *side by side as if for the purpose of comparison;* hence sometimes *similarity*, and sometimes *contrariety;* as *para*dox. (*Para* has also the form of *par* as *par*ody.)

Peri, *round about*, as *peri*phrasis.

Syn, *together*, as *syn*thesis. (*Syn* has also the forms *sy*, *syl*, *sym*, as *sy*stem, *syl*logism, *sym*pathy.)

II. AFFIXES.

An	denoting the *agent* or *doer* of a thing,	as Comedi*an*
Ant		Assist*ant*
Ar		Li*ar*
Ard		Drunk*ard*
Ary		Advers*ary*
Eer		Chariot*eer*
Ent		Correspond*ent*
Er		Build*er*
Ist		Psalm*ist*
Ive		Representat*ive*
Or		Govern*or*
Ster		Game*ster*
Ate	denoting the *person acted upon*, and equivalent to the passive termination *ed*,	as Deleg*ate*
Ee		Trust*ee*
Ite		Favour*ite*
Acy	denoting *being* or *state of being* taken abstractly,	as Lun*acy*
Age		Parent*age*
Ance		Vigil*ance*
Ancy		Brilli*ancy*
Ence		Adher*ence*
Ency		Consist*ency*
Hood		Boy*hood*
Ion		Cohes*ion*
Ism		Hero*ism*
Ment		Abase*ment*
Mony		Acri*mony*
Ness		Bald*ness*
Ry		Rival*ry*
Ship		Lord*ship*
Th		Warm*th*
Tude		Servi*tude*
Ty or ity		Pover*ty*, brev*ity*
Ure		Legisla*ture*
Y		Master*y*
Dom	denoting *jurisdiction*,	as King*dom*
Ric		Bishop*ric*
Cle	diminutive terminations,	as Corpus*cle*
Kin		Lamb*kin*
Let		Stream*let*
Ling		Duck*ling*
Ock		Hill*ock*

Ac	denoting *of* or *pertaining to,*	as Elegi*ac*
Al		Autumn*al*
An		Sylv*an*
Ar		Pol*ar*
Ary		Parliament*ary*
En		Gold*en*
Ic *or* ical		Angel*ic* or angel*ical*
Ile		Puer*ile*
Ine		Infant*ine*
Ory		Olfact*ory*
Ate	denoting *full of* or *abundance,*	as Affection*ate*
Ful		Care*ful*
Ose		Verb*ose*
Ous		Zeal*ous*
Some		Toil*some*
Y		Flower*y*
Ish	denoting *likeness,*	as Child*ish*
Like		God*like*
Ly		Soldier*ly*
Ive	denoting *capacity in an active sense,*	as Persuas*ive*
Able	denoting *capacity in a passive sense,*	as Laud*able*
Ible		Elig*ible*
Less	denoting *privation,*	as Worth*less*
Ish	denoting *a smaller degree of,*	as Green*ish*
Ate	denoting *to make,*	as Perpetu*ate*
En		Hard*en*
Fy		Puri*fy*
Ish		Stabl*ish*
Ise		Modern*ise*
Ize		Civil*ize*
Escent	denoting *progression,*	as Conval*escent*
Ly	denoting *like* in quality,	as Tru*ly*
Ward	denoting *in the direction of,*	as Down*ward*

III. LATIN ROOTS WITH THEIR ENGLISH REPRESENTATIVES.

Root and Meaning.	Representative.	Example.
Acris, sharp	*acri*	*acri*mony
Acuo, I sharpen, acūtus, sharpened	*acu*, *acut*	*acu*men, *acut*e
Aedes, a house	*edi*	*edi*fy, *edi*fice
Aequus, equal	*equ*, *equi*	*equ*animity, *equi*librium
Aër, aeris, air	*aeri*	*aeri*al, *aeri*form
Aether, the sky	*ether*	*ether*eal
Aevum, an age	*ev*	co*ev*al
Ager, agri, a field	*agri*	*agri*culture
Agger, a heap	*agger*	ex*agger*ate
Ago, I do, actus, done	*ag*, *act*	*ag*ent, *act*or
Ala, a wing	*ali*	*ali*ped
Alăcer, cheerful	*alacr*	*alacr*ity
Aliēnus, belonging to another	*alien*	*alien*, *alien*ate
Alo, I nourish	*ali*	*ali*ment
Alter, another	*alter*	*alter*ation
Altus, high	*alt*, *alti*	ex*alt*, *alti*tude
Amīcus, a friend	*amic*, *imic*	*amic*able, in*imic*al
Amo, I love	*am*, *amor*	*am*iable, *amor*ous
Amor, love		
Amplus, large	*ampli*	*ampli*fy
Ango, anxi, I vex	*ang*, *anxi*	*ang*uish, *anxi*ety
Angŭlus, a corner	*angul*, *angl*	*angul*ar, tri*angl*e
Anĭmus, mind	*anim*	*anim*ate, un*anim*ous, *anim*advert
Annus, a year	*ann*, *annu*, *enni*	*ann*als, *annu*al, bi*enni*al
Antīquus, ancient	*antiqu*	*antiqu*e
Aperio, I open, apertus, opened	*aperi*, *apert*	*aperi*ent, *apert*ure
Apto, I fit	*apt*	ad*apt*ation
Aqua, water	*aqua*, *aque*	*aqua*tic, *aque*duct
Arbĭter, a judge or umpire	*arbiter*, *arbitr*	*arbiter*, *arbitr*ary
Arbor, a tree	*arbor*, *arbour*	*arbor*aceous, *arbour*
Arceo, I drive away (erceo when compounded)	*erc*	co*erc*ion
Arma, arms	*arm*	*arm*y, *arm*istice
Aro, I plough	*ar*	*ar*able
Ars, artis, art	*art*, *ert*	*art*ful, in*ert*,
Artus, the joints	*arti*	*arti*culate
Asper, rough	*asper*	*asper*ity, ex*asper*ate
Audio, I hear, audītus, heard	*audi*, *audit*	*audi*ence, *audit*, *audit*ory
Augeo, I increase, auctus, increased	*aug*, *auct*, *auth*	*aug*ment, *auct*ion, *auth*or
Auspex, auspĭcis, a soothsayer	*auspic*	*auspic*ious
Avĭdus, greedy	*avid*	*avid*ity
Avis, a bird	*avi*	*avi*ary

Root and Meaning.	Representative.	Example.
Bacchus, the god of wine	*bacch*	*bacch*anal
Barba, a beard	*barb*	*barb*, *barb*er
Beātus, blessed	*beati*	*beati*tude
Bellum, war	*belli*, *bel*	*belli*gerent, re*bel*
Bellus, beautiful	*bell*	em*bell*ish
Bene, well	*bene*	*bene*diction
Bibo, I drink	*bib*	im*bib*e, wine-*bib*ber
Bini, two by two	*bin*	com*bin*ation
Bis, twice	*bi*	*bi*ped
Brevis, short	*brevi*	*brevi*ty, ab*brevi*ate
Cado, I fall, casus, fallen; (changed into cĭdo when compounded)	*cad*, *casu*, *cid*	*cad*averous, *casu*al, ac*cid*ent
Cædo, I cut, cæsus, cut; (changed into cīdo and cīsus when compounded)	*cid*, *cis*	homi*cid*e, in*cis*ion, pre*cis*e
Calor, heat	*calor*	*calor*ic
Calx, calcis, lime	*calc*	*calc*areous
Campus, a plain	*camp*, *champ*	en*camp*, *champ*aign
Cando, I set on fire, census, inflamed	*cand*, *cens*, *cend*	in*cand*escence, in*cens*e, in*cend*iary
Canis, a dog	*can*	*can*ine
Cano, canto, I sing	*cant*, *cent*	*cant*icles, pre*cent*or
Capillus, hair	*capill*	*capill*ary
Capio, I take, captus, taken; (cipio and ceptus when compounded)	*cap*, *cip*, *cipi*, *capt*, *cept*	*cap*able, anti*cip*ate, re*cipi*ent, *capt*ure, re*cept*ion
Caput, capĭtis, the head	*capit*, *cipit*	*capit*al, pre*cipit*ate
Carcer, a prison	*carcer*	in*carcer*ate
Caro, carnis, flesh	*carn*, *carni*	in*carn*ate, *carni*vorous
Carus, dear	*car*	*car*ess
Cavus, hollow	*cav*	ex*cav*ate, con*cav*e
Cedo, I give place, I go; cessio, a giving place to	*ced*, *ceed*, *cess*	re*ced*e, suc*ceed*, con*cess*ion, ac*cess*
Celer, swift	*celer*, *celeri*	ac*celer*ate, *celeri*ty
Centum, a hundred	*cent*	*cent*ury, *cent*ennial
Cera, wax	*cer*	*cer*ements
Cerno, I see, I sift; cretus, sifted	*cern*, *cret*, *creet*	dis*cern*, se*cret*ion, dis*creet*
Certus, certain	*certi*	*certi*fy
Cete, whales	*cet*, *ceti*	*cet*aceous, sperma*ceti*
Charta, paper	*chart*	*chart*, *chart*er
Cinctus, girt about	*cinct*	suc*cinct*, pre*cinct*s
Cio, I call, I summon	*cit*	*cit*e, *cit*ation
Civis, a citizen	*civi*	*civi*l, *civi*lize
Clamo, I cry out	*clam*, *claim*	ex*clam*ation, pro*claim*
Clarus, clear	*clar*, *clari*	de*clar*e, *clari*fy
Claudo, I shut, clausus, shut; (changed into cludo and clusus when compounded)	*clud*, *claus*, *clus*	ex*clud*e, *claus*e, se*clus*ion
Clemens, mild or merciful	*clemen*	*clemen*cy
Clino, I bend	*clin*	re*clin*e
Clivus, a slope	*cliv*, *clivi*	pro*cliv*e, de*clivi*ty
Coelum, heaven	*cel*	*cel*estial
Colo, I cultivate, cultus, cultivated	*col*, *cult*	*col*ony, *cult*ure

Root and Meaning.	Representative.	Example.
Colossus, a statue of enormous size	*coloss*	*coloss*al
Comes, comĭtis, a companion	*comit*	con*comit*ant
Commŏdus, convenient	*commod*	ac*commod*ate
Commūnis, common	*commun*, *communi*	*commune*, *communic*ate
Copia, plenty	*copi*	*copi*ous
Coquo, I boil, coctus, boiled	*cook*, *coct*	*cook*, de*coct*ion
Cor, cordis, the heart	*cord*, *cordi*	con*cord*, *cordi*al
Cornu, a horn	*corn*, *cornu*	uni*corn*, *cornu*copia
Corpus, corpŏris, the body	*corpus*, *corpor*, *corpu*	*corpus*cle, in*corpor*ate, *corpu*lent
Cras, to-morrow	*cras*	pro*cras*tinate
Credo, I trust	*cred*	*cred*it, *cred*ulous, *cred*ible
Cremo, I burn	*crem*	in*crem*ation
Crepo, I make a noise	*crep*	de*crep*itation
Cresco, I grow	*cresc*, *creas*	ex*cresc*ence, in*creas*e
Crimen, crimĭnis, a charge	*crimin*	*crimin*al
Crux, crucis, a cross	*cruci*	*cruci*fy
Cubo, I lie; (cumbo when compounded)	*cub*, *cumb*	in*cub*ation, in*cumb*ent
Culīna, a kitchen	*culin*	*culin*ary
Culpa, a fault, culpo, I find fault with	*culp*	*culp*able, *culp*rit
Cumŭlus, a heap	*cumul*	ac*cumul*ate
Cura, care	*cura*, *cur*	*cura*tor, sine*cur*e
Curro, I run	*cur*, *curr* }	in*cur*, *curr*icle, suc*cour*, ex*curs*ion, inter*cours*e
Cursus, a running	*cour*, *curs*, *cours* }	
Curtus, short	*curt*	*curt*ail
Curvus, crooked	*curv*, *curvi*	*curv*e, *curvi*linear
Cutis, the skin	*cuti*	*cuti*cle
Damno, I condemn	*damn*, *demn*	*damn*able, con*demn*
Datus, given; (ditus when compounded)	*dit*	ad*dit*ion
Decor, decōris, grace, beauty	*decor*	*decor*ous, *decor*ation
Dens, dentis, a tooth	*dent*	*dent*ist, *dent*ifrice
Densus, thick	*dens*, *densi*	con*dens*e, *dens*ity
Deus, a god	*Dei*	*Dei*ty, *dei*fy
Dexter, right-handed, clever	*dexter*, *dexteri*	*dexter*ous, *dexter*ity
Dico, I say, dictus, said	*dict*	pre*dict*, *dict*ate
Dies, day	*di*	*di*al, *di*ary, meri*di*an
Dignus, worthy	*dign*, *digni*	con*dign*, *digni*ty
Dimidium, half (Fr. demi)	*demi*	*demi*-god
Diurnus, daily	*diurn*, *journ*	*diurn*al, *journ*al
Doceo, I teach, doctus, taught	*doc*, *doct*	*doc*ile, *doct*or
Doleo, I grieve	*dol*	con*dol*e
Dolor, grief	*dolor*	*dolor*ous
Domĭnus, a master	*domin*	*domin*eer, *domin*ican
Domus, a house	*dom*, *domi*	*dom*estic, *domi*cile
Donum, a gift	*don*	*don*ation
Dormio, I sleep	*dorm*	*dorm*ant
Duco, I lead, ductus, led	*duc*, *duct*	in*duc*e, aque*duct*
Duo, two	*du*	*du*al, *du*el
Durus, hard	*dur*	*dur*able
Ebrius, drunken.	*ebri*	*ebri*ety, in*ebri*ate

Root and Meaning.	Representative.	Example.
Edo, I eat	*ed*	*ed*ible
Ego, I	*ego*	*ego*tist
Emo, I buy, emptus, bought	*eem*, *empt*	red*eem*, ex*empt*ion
Emŭlus, a rival	*emul*	*emul*ation, *emul*ous
Erro, I wander	*err*	ab*err*ation
Exter, outward	*exter*	*exter*nal
Faber, a workman	*fabr*	*fabr*ic
Facies, the face	*faci*, *fici*	*faci*al, super*fici*al
Facĭlis, easy	*facil*, *facul*, *ficul*	*facil*itate, *facul*ty, dif*ficul*ty
Facio, I make, fio, I am made, factus, made; (ficio and fectus when compounded)	*fact*, *fect*, *fit*, *fic*, *fy*	*fact*or, per*fect*, bene*fit*, sopori*fic*, puri*fy*
Fallo, I deceive	*fall*	in*fall*ible
Fames, hunger	*fam*	*fam*ine
Fanum, a temple	*fan*,	pro*fan*ation
Fari, to speak, fatus, having spoken	*fa*, *fat*	inef*fa*ble, *fate*
Felix, felĭcis, happy	*felici*	*felicit*y
Femĭna, a woman	*femin*	*femin*ine, ef*femin*acy
Fero, I carry	*fer*	*fer*ry, in*fer*, circum*fer*ence
Fervio, I boil	*ferv*	*ferv*id, ef*ferv*escence
Fidēlis, faithful	*fidel*	*fidel*ity
Fido, I trust	*fid*	con*fid*e, dif*fid*ence
Filia, a daughter Filius, a son	*fili*	*fili*al, af*fili*ate
Filum, a thread	*fil*	*fil*ament
Fingo, I feign, fictus, feigned	*fig*, *fict*	*fig*ment, *fict*ion, *fict*itious
Finis, an end, finītus, finished	*fin*, *finit*	*fin*al, *finit*e, de*finit*e, de*finit*ive
Firmus, strong	*firm*	con*firm*
Fiscus, the public treasury	*fisc*	*fisc*al, con*fisc*ate
Fissus, cleft	*fiss*	*fiss*ure
Flagro, I burn	*flagr*	*flagr*ant, con*flagr*ation
Flatus, a puff of wind	*flat*, *flatu*	in*flat*ion, *flatu*lent
Flecto, I bend, flexus, bent	*flect*, *flex*	re*flect*, *flex*ible
Fligo, I dash, flictus, dashed	*flict*	con*flict*
Flos, floris, a flower	*flor*	*flor*ist, *flor*al
Fluctus, a wave	*fluctu*	*fluctu*ate
Fluo, I flow, fluxus, a flowing	*flu*, *flux*	*flu*ent, re*flux*
Foedus, foedĕris, a treaty	*feder*	con*feder*ate
Folium, a leaf	*foli*, *foil*	*foli*ate, tre*foil*
Foro, I bore	*for*	per*for*ate
Fors, fortis, chance	*fort*	*fort*uitous
Fortis, strong	*forti*	*forti*fy
Fossa, a ditch	*foss*	*foss*e
Fossus, dug	*foss*	*foss*il
Frango, I break, fractus, broken; (fringo when compounded)	*frag*, *fract*, *fring*	*frag*ment, *fract*ure, in*fring*e
Frater, a brother	*frater*, *fratri*	*frater*nal, *fratri*cide

Root and Meaning.	Representative.	Example.
Frigeo, I am cold	*frig*	*frig*id, re*frig*eration
Frons, frontis, the forehead	*frontis*, *front*	*frontis*piece, af*front*
Fructus, fruit	*fructi*	*fructi*fy
Fruor, I enjoy	*fru*	*fru*ition
Frustra, in vain	*frustr*	*frustr*ate
Fugio, I flee, fugĭtus, fled	*fug*, *fugit*	re*fug*e, *fugit*ive
Fulgeo, I shine	*fulg*	re*fulg*ent
Fulmen, fulmĭnis, lightning	*fulmin*	*fulmin*ate
Fumus, smoke	*fum*, *fumi*	per*fume*, *fum*igate
Functus, having performed	*funct*	*funct*ion
Fundo, I pour out, fusus, poured out	*fund*, *fus*	re*fund*, *fus*ible, in*fuse*
Fundus, the bottom of anything	*fund*, *found*	*fund*amental, pro*found*
Gallus, a cock	*gall*	*gall*inaceous
Gelu, frost	*gel*, *geal*	con*gel*ation, con*geal*
Gens, gentis, a nation	*gent*	*gent*ile
Genu, a knee	*genu*	*genu*flexion
Genus, genĕris, kind or kindred, genĕra, kinds	*gener*, *genera*	de*gener*ate, *genera*
Germen, germĭnis, a bud	*germin*	*germin*ate
Gero, I carry, gestus, carried	*ger*, *gest*	belli*ger*ent, *gest*ure
Gigas, gigantis, a giant	*gigan*	*gigan*tic
Gigno, I beget, genĭtus, begotten	*gen*, *genit*	pro*geny*, pro*genit*or
Glacies, ice	*glaci*	*glaci*al, *glaci*er
Glomus, glomĕris, a ball or clue	*glomer*	ag*glomer*ation
Gluten, glutĭnis, glue	*glutin*	*glutin*ous
Gradior, I go, gradus, a steep, gressus, having gone	*grad*, *gred*, *gradu*, *gress*	retro*grade*, in*gred*ient, *gradu*ate, ag*gress*ion
Gramen, gramĭnis, grass	*gramini*	*gramini*vorous
Grandis, great	*grandi*	*grandi*loquent
Gratia, favour	*grat*, *grati*, *grac*	*grat*uitous, in*grati*ate, *grace*
Gratus, grateful, agreeable	*grat*, *grati*	in*grat*e, *grati*tude
Gravis, heavy	*gravi*	*gravi*ty
Grex, gregis, a flock	*greg*	*greg*arious, e*greg*ious
Gusto, I taste	*gust*	dis*gust*
Habeo, I have, habĭtus, had	*habit*, *hibit*	*habit*, in*habit*, ex*hibit*
Haereo, I stick, haesus, stuck	*her*, *hes*	ad*her*e, co*hes*ion
Haeres, haerēdis, an heir	*hered*, *herit*	*hered*itary, in*herit*
Halo, I breathe	*hal*	ex*hal*e, ex*hal*ation
Haurio, I draw, haustus, drawn	*haust*	ex*haust*
Herba, an herb	*herb*	*herb*al, *herb*ivorous
Hilăris, cheerful	*hilar*	ex*hilar*ate, *hilar*ity
Histrio, a player	*histrion*	*histrion*ic
Homo, a man	*homi*, *hum*	*homi*cide, *hum*an
Hora, an hour	*hor*, *horo*	*hor*al, *horo*loge
Hortor, I exhort	*hort*	ex*hort*
Hospes, hospĭtis, a guest	*hospit*	*hospit*able
Hostis, an enemy	*host*	*host*ile
Humĭdus, moist	*humid*, *humidi*	*humid*, *humidi*ty

Root and Meaning.	Representative.	Example.
Humus, the ground	*hum*	in*hum*ation, post*hum*ous
Idem, the same	*iden*	*iden*tity
Ignis, fire	*igni*, *igne*	*igni*tion, *igne*ous
Imāgo, imagĭnis, an image	*imag*, *imagin*	*imag*e, *imagin*ation
Imperium, power or government	*imper*	*imper*ial
Index, indĭcis, a pointer, a discoverer	*indic*	*indic*ate
Infra, below	*infern*	*infern*al
Initium, a beginning	*initi*	*initi*ate
Insŭla, an island	*insula*, *insul*	pen*insula*, *insul*ate
Intĕger, entire	*integr*	*integr*ant
Intra, intus, within	*inter*, *inti*	*inter*nal, *inti*mate
Ira, anger	*ir*, *ira*, *irr*	*ir*e, *ira*scible, *irr*itable
Iter, itinĕris, a journey	*itiner*	*itiner*ate
Itĕrum, again	*iter*	*iter*ation
Itum, to go	*it*	ex*it*, circu*it*, trans*it*, sed*it*ion
Jaceo, I lie	*jac*	ad*jac*ent
Jactus, thrown; (jectus when compounded)	*ject*	in*ject*, con*ject*ure
Janua, a gate	*jan*	*jan*itor
Jubĭlum, a shout of joy	*jubil*	*jubil*ee
Judex, judĭcis, a judge	*judic*	*judic*ial
Jugum, a yoke	*jug*	con*jug*ate
Junctus, joined	*junct*	ad*junct*, con*junct*ion
Juro, I swear	*jur*	con*jur*e
Jus, juris, right, law	*juris*, *juri*	*juris*diction, *juri*dical
Jutus, assisted	*jut*	ad*jut*ant, coad*jut*or
Juvĕnis, a youth	*juven*	*juven*ile
Lac, lactis, milk	*lact*	*lact*eal
Lacer, torn	*lacer*	*lacer*ate
Laedo, I hurt, laesus, hurt; (lido and lisus when compounded)	*lid*, *lis*	col*lid*e, col*lis*ion
Lambo, I lick	*lamb*	*lamb*ent
Lamĭna, a thin plate	*lamina*	*lamina*ble
Lapis, lapĭdis, a stone	*lapid*	*lapid*ary, di*lapid*ate
Lapsus, having slipped or fallen	*laps*	re*laps*e, col*laps*e
Latus, carried	*lat*	e*lat*ion
Latus, wide	*lat*	di*lat*e
Latus, latĕris, a side	*later*	*later*al
Laus, laudis, praise	*laud*	*laud*able, *laud*atory
Lavo, I wash, lotus, washed	*lav*, *lot*	*lav*e, *lot*ion
Laxus, loose	*lax*	re*lax*
Legātus, an ambassador	*legat*	de*legat*e
Lego, I bequeath	*lega*	*lega*cy
Lego, I gather, I choose, lectus, gathered	*leg*, *lect*	al*leg*e, col*lect*
Lenis, gentle	*len*	*len*ity
Lentus, gentle	*lent*	re*lent*
Lethum, letum, death	*leth*, *let*	*leth*al, *let*al
Levis, light	*lev*	*lev*ity
Levo, I lighten, I lift up	*lev*	e*lev*ate, *lev*er
Lex, legis, a law	*legis*, *leg*	*legis*lator, *leg*al
Liber, a book	*libr*	*libr*ary
Liber, free	*liber*	*liber*ty, *liber*al, *liber*tine
Libra, a balance	*libr*	*libr*ation, equi*libr*ium

Root and Meaning.	Representative.	Example.
Licet, it is lawful	*licit*	il*licit*
Lignum, wood	*lignum*, *lign*	*lignum*vitæ, *lign*eous
Ligo, I bind	*lig*, *liga*	ob*lig*e, *liga*ment
Linea, a line	*linea*	*linea*ment
Linquo, I leave, lictus, left	*linqu*, *lict*	re*linqu*ish, re*lict*
Liqueo, I melt	*lique*	*lique*faction
Lis, litis, strife	*liti*	*liti*gious
Litĕra, a letter	*liter*, *litera*	*liter*al, *litera*ture
Locus, a place	*loco*, *loc*	*loco*motion, *loc*ality
Longus, long	*long*, *longi*	e*long*ate, *longi*tude
Loqui, to speak	*loqui*, *loquy*, *loqu*, *locu*	col*loqui*al, ob*loquy*, *loqu*acity, ventri*loqu*ist, e*locu*tion
Lucrum, gain	*lucr*	*lucr*ative
Luctor, I struggle	*luct*	re*luct*ant
Ludo, I play, lusus, deceived	*ludi*, *lus*	*ludi*orous, il*lus*ion
Lumen, lumĭnis, light	*lumin*	*lumin*ary
Luna, the moon	*lun*	*lun*atic, sub*lun*ary
Luo, I wash	*lu*, *lut*, *luv*	ab*lu*ent, di*lut*e, al*luv*ial
Lustro, I purify	*lustr*	*lustr*e, *lustr*ation, il*lustr*ate
Lux, lucis, light	*luc*	*luc*id
Macies, leanness	*maci*	e*maci*ate
Macŭla, a spot	*macul*	im*macul*ate
Magnus, great	*magni*	*magni*fy
Major, greater	*major*	*major*ity
Malè, ill, wrongly, wickedly	*male*, *mal*	*male*volent, *mal*versation
Malleus, a hammer	*mall*, *malle*	*mall*et, *malle*able
Mamma, a breast	*mamma*, *mammi*	*mamma*lia, *mammi*ferous
Mando, I bid	*mand*	com*mand*, *mand*ate
Mando, I chew	*mand*	*mand*ible
Maneo, I stay	*man*, *main*	per*man*ent, re*main*
Mano, I flow	*man*	e*man*ate
Manus, a hand	*manu*, *mani*	*manu*al, *mani*pulation
Mare, the sea	*mar*, *mari*	*mar*ine, *mari*time
Mars, martis, the god of war	*mart*	*mart*ial
Mater, matris, a mother	*mater*, *matri*	*mater*nal, *matri*cide
Matūrus, ripe	*matur*, *maturi*	*matur*e, *maturi*ty
Medius, middle	*medi*	*medi*ator, *medi*um
Mel, mellis, honey	*mell*	*mell*ifluous
Melior, better	*melior*	a*melior*ate
Memor, mindful	*memor*	*memor*able
Mens, mentis, the mind	*ment*	*ment*al
Mergo, I plunge, mersus, plunged	*merg*, *mers*	e*merg*e, im*mers*ion
Merĭtus, deserved	*merit*	*merit*orious
Merx, mercis, merchandise	*merc*	com*merc*ial
Metior, I measure, mensus, measured	*met*, *mensu*	*met*e, com*mensu*rate
Migro, I remove	*migr*	*migr*ate
Miles, milĭtis, a soldier	*milit*	*milit*ant
Mille, a thousand	*mill*	*mill*ennium
Minister, a servant	*minister*, *ministr*	ad*minister*, ad*ministr*ation
Minor, less	*minor*	*minor*, *minor*ity

Root and Meaning.	Representative.	Example.
Minuo, I lessen	*minu*, *min*	di*minu*tion, di*min*ish
Miror, I gaze	*mir*	*mir*ror, ad*mir*e
Miser, wretched	*miser*	*miser*able
Mitis, mild	*miti*	*miti*gate
Mitto, I send, missus, sent	*mit*, *miss*	re*mit*, *miss*ionary
Modus, a measure	*mod*, *modi*	*mod*e, *modi*fy
Mola, a mill, meal or flour	*mol*	e*mol*ument
Moles, a mass	*mol*	*mol*est, de*mol*ish
Mollis, soft	*molli*	e*molli*ent, *molli*fy
Moneo, I warn, monĭtus, warned	*mon*, *monit*	ad*mon*ish, *monit*or
Monstro, I point out	*monstr*	de*monstr*ate
Mors, mortis, death	*mort*, *morti*	im*mort*al, *morti*fy
Mos, moris, a manner	*mor*	*mor*al
Moveo, I move, motus, moved	*mov*, *mot*	im*mov*able, re*mot*e
Mucus, slimy matter	*muci*	*muci*laginous
Multus, many	*multi*	*multi*form
Munītus, fortified	*munit*	*munit*ion
Munus, munĕris, a gift	*muner*	re*muner*ate
Murus, a wall	*mur*	im*mur*e
Muto, I change	*mut*	*mut*able
Nasus, the nose	*nas*	*nas*al
Natus, born	*nat*	*nat*ive, *nat*al
Nausea, loathing	*nause*	*nause*ous
Navis, a ship	*nav*, *navi*	*nav*al, *navi*gate
Necto, I tie, nexus, tied	*nect*, *nex*	con*nect*, an*nex*
Nego, I deny	*neg*	*neg*ative
Nervus, a sinew	*nerv*	e*nerv*ate
Neuter, neither	*neuter*, *neutr*	*neuter*, *neutr*al
Niger, black	*negro*	*negro*
Nihil, nothing	*nihil*	an*nihil*ate
Noceo, I hurt, nocens, hurtful	*nocu*, *nocen*, *noxi*	in*nocu*ous, in*nocen*t, *noxi*ous
Nodus, a knot	*nod*	*nod*e
Nomen, nomĭnis, a name	*nomin*	de*nomin*ate
Non, not	*non*	*non*entity
Norma, a rule	*norm*	e*norm*ous
Nosco, I learn to know, notus, known	*nosc*, *not*, *niz*, *nit*	cog*nosc*ible, *not*ify, cog*niz*ance, recog*nit*ion
Novus, new	*nov*	in*nov*ate, *nov*ice
Nox, noctis, night	*nox*, *noct*	equi*nox*, *noct*urnal
Nubo, I marry, nuptus, married	*nub*, *nupt*	con*nub*ial, *nupt*ials
Nudus, naked	*nud*	de*nud*e
Nugae, trifles	*nug*	*nug*atory
Nullus, none	*nul*, *nulli*	an*nul*, *nulli*fy
Numĕrus, a number	*numer*	*numer*ation
Nuncio, I tell	*nunci*, *nounc*	an*nunci*ation, re*nounc*e
Nutrio, I nourish	*nutri*	*nutri*ment
Oblīquus, aslant	*obliqu*	*obliqu*ity
Oblivio, forgetfulness	*oblivi*	*oblivi*on
Occultus, hidden	*occult*	*occult*
Octo, eight	*oct*	*oct*agon
Ocŭlus, the eye	*ocul*	*ocul*ist
Odium, hatred	*odi*	*odi*ous
Odor, smell	*odor*	*odor*iferous

Root and Meaning.	Representative.	Example.
Officium, service, duty	*offic*	*offic*ial
Oleo, I smell	*ol*	*ol*factory, red*ol*ent
Omnis, all	*omni*	*omni*potent
Onus, onĕris, a burden	*oner*	*oner*ous, ex*oner*ate
Opācus, dark	*opac*, *opaqu*	*opac*ity, *opaqu*e
Opto, I wish	*opt*	ad*opt*, *opt*ion
Opus, opĕris, a work	*oper*	*oper*ose, *oper*ation
Orbis, a circle	*orbi*	*orbi*cular
Ordo, ordĭnis, order	*ord*, *ordin*	*ord*ain, *ordin*ary, sub*ordin*ate
Oriens, orientis, rising, eastern	*orient*	*orient*al
Orno, I deck	*orn*	ad*orn*, *orn*ament
Oro, I speak, I plead, I beseech	*ora*	inex*ora*ble, *ora*tor
Os, ossis, a bone	*oss*	*oss*ify
Os, oris, the mouth	*or*, *ori*	*or*al, ad*or*ation, *ori*fice
Oscillum, a moving backwards and forwards	*oscill*	*oscill*ate
Otium, ease	*oti*	*oti*ose, neg*oti*ate
Ovum, an egg	*ov*	*ov*al, *ov*iform
Pactus, having bargained	*pact*	com*pact*
Pando, I spread, passus or pansus, spread	*pand*, *pass*, *pans*	ex*pand*, com*pass*, ex*pans*e
Par, equal	*par*	*par*ity
Pareo, I appear	*par*	ap*par*ent
Pario, I bring forth	*par*	*par*ent, vivi*par*ous
Paro, I prepare	*par*, *pair*	re*par*ation, re*pair*
Passer, a sparrow	*passer*	*passer*ine
Pastus, fed	*past*	*past*or
Pater, patris, a father	*pater*, *patri*, *parri*	*pater*nal, *patri*mony, *parri*cide
Patior, I suffer, passus, having suffered	*pati*, *pass*	*pati*ent, *pass*ive, *pass*ion
Patria, one's native country	*patri*	*patri*ot
Pauci, few	*pauci*	*pauci*ty
Pauper, poor	*pauper*	*pauper*ism
Pax, pacis, peace	*paci*	*paci*fic
Pecco, I sin	*pecc*	im*pecc*able
Pectus, pectŏris, the breast	*pector*	ex*pector*ate
Peculium, property	*pecul*	*pecul*ation
Pecunia, money	*pecunia*	*pecunia*ry
Pellis, a skin	*pelli*	*pelli*cle
Pello, I drive away, pulsus, driven	*pel*, *puls*	ex*pel*, re*puls*ion
Pendo, I hang, I weigh; pensus, hung, weighed	*pend*, *pens*	de*pend*, *pend*ulum, sti*pend*, *pens*ive, com*pens*ate
Pene, almost	*pen*	*pen*insula
Perdĭtus, lost	*perdit*	*perdit*ion
Perior, I try, perītus, skilled	*peri*, *pert*	ex*peri*ment, ex*pert*
Pes, pedis, the foot	*ped*	bi*ped*
Pestis, a plague	*pest*, *pesti*	*pest*, *pesti*ferous
Peto, I seek, petītus, sought	*pet*, *petit*	centri*pet*al, com*petit*ion
Pingo, I paint, pictus, painted	*paint*, *pict*	*paint*er, de*pict*
Pio, I worship, I appease; piātus, appeased	*pia*, *piat*	*pia*cular, ex*piat*e

Root and Meaning.	Representative.	Example.
Piscis, a fish, piscor, I fish	*pisca*	*pisca*tory
Pius, pious	*pi*, *pie*	*pi*ous, *pie*ty
Placeo, I please	*plac*	*plac*id
Placo, I appease	*plac*	im*plac*able
Plaudo, I clap my hands, I praise	*plaud*, *plaus*	ap*plaud*, ap*plause*
Plebs, the common people	*pleb*	*pleb*eian
Plenus, full	*plen*, *pleni*	re*plen*ish, *pleni*tude
Pleo, I fill, pletus, filled	*ply*, *plet*	sup*ply*, com*plete*, ex*ple*tive
Plexus, twisted	*plex*	com*plex*
Plico, I fold	*plic*	com*plic*ate
Ploro, I wail	*plor*	de*plor*e
Plumbum, lead	*plumb*, *plum*	*plumb*er, *plum*met
Pœna, punishment	*pen*, *pun*	*pen*al, im*pun*ity
Pono, I place, posĭtus, placed	*pon*, *pos*, *posit*	de*pone*, im*pose*, *posit*ion
Popŭlus, the people	*popul*	*popul*ar
Porto, I carry, porta, a gate	*port*	ex*port*, *port*able, *port*al
Potens, potentis, powerful	*potent*, *potenti*	*potent*ate, pleni*potenti*ary
Poto, I drink	*pot*	*pot*ion
Præda, plunder	*preda*	*preda*tory, de*preda*tion
Pravus, wicked	*prav*, *pravi*	de*prave*, de*pravi*ty
Precor, I pray	*prec*	de*prec*ate
Prehendo, I take, prehensus, taken	*prehend*, *prehens*	ap*prehend*, com*prehens*ion
Pretium, a price	*preci*	ap*preci*ate
Primus, first	*prim*	*prim*ary, *prim*eval
Privo, I take away, privātus, taken away	*priv*, *privat*	de*prive*, *privat*ion
Probo, I prove	*prob*	*prob*able
Probus, good	*probi*	*probi*ty
Proprius, one's own	*propri*	ap*propri*ate
Pudens, pudentis, bashful	*pudent*	im*pudent*
Puer, a boy	*puer*	*puer*ile
Pugna, a fight	*pugna*, *pugn*	*pugna*cious, im*pugn*
Pulvis, pulvĕris, dust	*pulver*	*pulver*ize
Punctum, a point	*punctu*	*punctu*ation
Pungo, I prick	*pung*	*pung*ent
Puto, I prune or lop, I think or reckon	*put*	am*put*ate, re*put*ation, dis*put*e
Putris, rotten	*putr*	*putr*efaction
Quaero, I ask, quaesītus, sought	*quir*, *quest*, *quisit*, *quer*	in*quir*e, in*quest*, re*quisit*ion, *quer*y
Quassus (cussus when compounded) shaken	*cuss*	dis*cuss*
Quatuor, four	*quadr*	*quadr*angle
Queror, I complain	*quer*	*quer*ulous
Quinque, five	*quinqu*	*quinqu*ennial
Radius, a ray	*radius*, *radi*	*radius*, *radi*ate
Radix, radīcis, a root	*radic*	*radic*al, e*radic*ate
Ramus, a branch	*rami*	*rami*fication
Rapio, I seize, I carry off by force; raptus, seized	*rap*, *rapt*	*rap*ine, *rapt*ure
Rarus, thin	*rar*	*rar*ity, *rar*efy
Rasus, scraped	*ras*	*ras*or, e*ras*e
Ratio, rationis, reason	*ration*	*ration*al

Root and Meaning.	Representative.	Example.
Recens, recentis, new	*recent*	*recent*
Rectus, straight	*recti*	*recti*lineal
Rego, I rule, rectus, ruled	*reg*, *rect*	*reg*al, *rect*or
Res, a thing	*re*	*re*al
Rete, a net	*reti*	*reti*culate, *ret*ina
Rideo, I laugh at, risus, laughed at	*rid*, *ris*	de*rid*e, *ris*ible
Rigo, I water	*rig*	ir*rig*ate
Robur, robŏris, strength	*robor*	cor*robor*ate
Rodo, I gnaw, rosus, gnawed	*rod*, *ros*	cor*rod*e, cor*ros*ion
Rota, a wheel	*rota*	*rota*tion
Rotundus, round	*rotund*	*rotund*ity
Rumen, rumĭnis, the throat	*rumin*	*rumin*ate
Ruptus, broken	*rupt*	bank*rupt*, e*rupt*ion
Rus, ruris, the country	*rus*, *rur*	*rus*tic, *rur*al
Sacer, sacred	*sacri*, *secr*	*sacri*fice, con*secr*ate
Sagus, wise	*sag*	*sag*e
Sal, salt	*sal*	*sal*ine
Salio, I leap, saltus, leapt; (silio and sultus when compounded)	*sali*, *sault*, *sil*, *sult*	*sali*ent, as*sault*, re*sil*e, in*sult*
Salvus, safe	*salv*	*salv*ation
Sanctus, holy	*sancti*	*sancti*fy
Sanguis, sanguĭnis, blood	*sanguin*	*sanguin*ary
Sanus, sound	*san*, *sani*, *sana*	*san*e, in*sani*ty, *sana*tory
Sapio, I taste; (sipio when compounded)	*sap*, *sip*	*sap*id, in*sip*id
Satis, enough	*satis*, *sati*	*satis*fy, *sati*ate
Satur, full	*satur*	*satur*ate
Saxum, a rock	*saxi*	*saxi*frage
Scando, I climb; (scendo when compounded)	*scend*	a*scend*
Scindo, I cleave, scissus, cleft	*scind*, *sciss*	re*scind*, re*sciss*ory
Scio, I know	*sci*	*sci*ence, pre*sci*ence
Scribo, I write, scriptus, written	*scrib*, *script*	in*scrib*e, *script*ure
Scrutor, I search thoroughly	*scrut*	*scrut*iny, in*scrut*able
Sculptus, carved	*sculpt*	*sculpt*ure
Scurra, a scoffer	*scurr*	*scurr*ility
Seco, I cut, sectus, cut	*seg*, *sect*	*seg*ment, dis*sect*
Sedeo, I sit, sessus, sat	*sed*, *sid*, *sess*	*sed*entary, as*sid*uous, *sess*ion
Semen, semĭnis, seed	*semin*	dis*semin*ate, *semin*ary
Semi, half	*semi*	*semi*circle
Senex, senis, old	*seni*	*seni*lity
Sentio, I feel, sensus, felt	*sent*, *sens*	*sent*ient, *sens*ation, dis*sent*
Sepelio, I bury, sepultus, buried	*sepul*, *sepult*	*sepul*chre, *sepult*ure
Sequor, I follow, secūtus, having followed	*sequ*, *secut*	sub*sequ*ent, per*secut*e, ex*ecut*e (ec-*secut*e)
Servo, I preserve	*serv*	ob*serv*e
Sidus, sidĕris, a star	*sider*	*sider*eal
Signum, a mark, signo, I mark	*sign*, *signi*	de*sign*ate, *signi*fy
Silva, a wood	*silv*	*silv*an
Simĭlis, like	*simil*, *simili*	*simil*ar, *simili*tude

Root and Meaning.	Representative.	Example.
Simul, at the same time	*simul*	*simul*taneous
Simŭlo, I feign	*simul*	dis*simul*ation
Sisto, I stop	*sist*	de*sist*
Socius, a companion	*soci*	*soci*al
Sol, the sun	*sol*	*sol*ar, *sol*stice
Solor, I comfort	*sol*	con*sole*
Solus, alone	*sol*, *soli*	*sole*, *sol*itude, *soli*loquy
Solvo, I loose, solūtus, loosed	*solv*, *solu*, *solut*	dis*solve*, *solu*ble, *solut*ion
Somnus, sleep	*somni*	*somni*ferous
Sono, I sound	*son*	*son*orous
Sopor, sopōris, a deep sleep	*sopor*	*sopor*ific
Sorbeo, I suck in, sorptus, sucked in	*sorb*, *sorpt*	ab*sorb*ent, ab*sorpt*ion
Sors, sortis, a lot	*sort*	as*sort*
Sparsus, spread; (spersus when compounded)	*spers*	di*sperse*
Spatium, space	*spati*, *spaci*	ex*pati*ate, *spaci*ous
Species, a form	*speci*	*speci*fic
Specio, I see, spectus, seen	*speci*, *spect*	*speci*ous, a*spect*
Specŭla, a watch-tower	*specul*	*specul*ate
Spero, I hope	*sper*, *spair*	de*sper*ate, de*spair*
Spiro, I breathe	*spir*	re*spir*ation, ex*pire* (ec-*spire*)
Spolio, I plunder, spoliatus, plundered	*spoil*, *spoliat*	de*spoil*, *spoliat*ion
Spondeo, I promise, sponsus, promised	*spond*, *spons*	re*spond*, re*sponse*
Spontis, of one's own accord	*spont*	*spont*aneous
Stagnum, standing water	*stagn*	*stagn*ant, *stagn*ation
Statuo, I set up, I appoint; statūtus, appointed; (stituo and stitūtus when compounded)	*statu*, *statut*, *stitu*, *stitut*	*statu*e, *statut*e, con*stitu*ent, sub*stitut*e
Stella, a star	*stell*	con*stell*ation
Sterĭlis, barren	*steril*, *sterili*	*steril*e, *sterili*ty
Stillo, I drop	*stil*	di*stil*
Stimŭlus, a spur	*stimul*	*stimul*ate
Stinguo, I put out, stinctus, extinguished	*stingu*, *stinct*	ex*tingu*ish, ex*tinct*
Stipŭla, a straw	*stipul*	*stipul*ate
Stirps, the trunk of a tree, offspring	*stirp*	ex*tirp*ate (ec-*stirp*ate)
Sto, I stand, stans, standing, statum, to stand	*stat*, *stant*, *stic*	*stat*ure, di*stant*, sol*stic*e
Stringo, I bind, strictus, bound	*string*, *strict*	a*string*ent, re*strict*
Struo, I pile up, structus, piled up	*struct*, *strue*, *stroy*	*struct*ure, con*strue*, de*stroy*
Stultus, a fool	*stulti*	*stulti*fy
Suadeo, I advise, suasus, advised	*suad*, *suas*	dis*suade*, per*suas*ive
Suavis, sweet	*suav*	*suav*ity
Summus, highest	*summ*	*summ*it, con*summ*ation
Sumo, I take, sumptus, taken	*sum*, *sumpt*	as*sume*, con*sumpt*ion

Root and Meaning.	Representative.	Example.
Surgo, I rise, surrectus, risen	*surg*, *surrect*	in*surg*ent, re*surrect*ion
Tacĭtus, silent	*tacit*	*tacit*, *tacitu*rn
Tango, I touch, tactus, touched	*tang*, *tig*, *tact*	*tang*ent, con*tig*uous, con*tact*
Tardus, slow	*tard*	re*tard*
Tego, I cover, tectus, covered	*teg*, *tect*	in*teg*ument, pro*tect*
Temno, I despise, temptus, despised	*temn*, *tempt*	con*temn*, con*tempt*ible
Tempus, tempŏris, time	*tempor*	*tempor*al, con*tempor*ary
Tendo, I stretch, tentus, stretched	*tend*, *tent*, *tens*	dis*tend*, ex*tent*, in*tense*
Teneo, I hold, tentus, held	*tain*, *tin*, *tent*	con*tain*, con*tin*ent, de*tent*ion
Tenuis, thin	*tenu*	*tenu*ity, at*tenu*ate
Tepeo, I am warm	*tep*, *tepe*	*tep*id, *tepe*faction
Terminus, a bound or limit	*termin*	*termin*ation, in*termin*able
Terra, the earth	*terr*, *ter*	*terr*aqueous, in*ter*
Testis, a witness	*test*, *testi*	at*test*, *testi*fy
Textus, woven	*text*	*tex*ture, con*text*
Tollo, I lift up	*tol*	ex*tol*
Torreo, I roast	*torr*	*torr*id
Tortus, twisted	*tort*	ex*tort*
Totus, the whole	*tot*	*tot*al
Tracto, I handle	*tract*	*tract*able
Traho, I draw, tractus, drawn	*trah*, *tract*	sub*trah*end, ex*tract*
Tremo, I tremble	*trem*	*trem*endous, *trem*ulous
Tribūtus, given	*tribut*	dis*tribut*e
Tritus, rubbed	*trit*	*trit*uration
Trudo, I thrust, trusus, thrust	*trud*, *trus*	in*trud*e, ob*trus*ion
Tuber, a bump	*tuber*	pro*tuber*ance
Tubus, a pipe	*tub*	*tub*e
Tueor, I see, I protect, I look	*tuit*	*tuit*ion, in*tuit*ive
Turba, a crowd	*turb*	*turb*ulent, dis*turb*
Turgeo, I swell	*turg*	*turg*id
Turpis, base	*turp*	*turp*itude
Uber, fertile	*uber*	ex*uber*ant
Ultimus, last	*ultim*	*ultim*ate
Umbra, a shadow	*umbra*, *umbr*	*umbra*geous, *umbr*ella
Unda, a wave	*und*	in*und*ate, *und*ulate
Unguo, I anoint, unctus, anointed	*ungu*, *unct*	*ungu*ent, *unct*ion
Unus, one	*un*, *uni*	*un*animous, *uni*form
Urbs, a city	*urbs*, *urb*	sub*urbs*, *urb*an
Ustus, burnt	*ust*	combu*st*ion
Utĭlis, useful	*utili*	*utili*ty
Uxor, a wife	*uxor*	*uxor*ious
Vacca, a cow	*vacc*	*vacc*ination
Vaco, I am empty	*vac* *vacu*	*vac*ation, *vac*ancy e*vacu*ate, *vacu*um
Vado, I go	*vad*, *vas*, *wad*	in*vad*e, in*vas*ion, *wad*e
Vagor, I wander	*vag*, *vagr*	*vag*abond, *vagr*ant
Valeo, I am strong	*val*, *vail*	pre*val*ent, pre*vail*

Root and Meaning.	Representative.	Example.
Vallus, a stake, a palisade	*val*	inter*val*
Vas, any kind of vessel	*vas*	*vas*e
Vasto, I lay waste	*vast*, *waste*	de*vast*ation, *waste*
Veho, I carry	*vehi*, *vey*	*vehi*cle, con*vey*
Velox, velōcis, swift	*veloc*	*veloc*ity
Venio, I come, ventus, come	*ven*, *vent*	con*vene*, ad*vent*
Ventus, the wind	*vent*	*vent*ilation
Ver, the spring	*vern*	*vern*al
Vergo, I incline	*verg*	di*verg*e
Vermis, a worm	*vermi*	*vermi*cular
Verna, a home-born slave	*verna*	*verna*cular
Verto, I turn, versus, turned	*vert*, *vers*	re*vert*, di*verse*, *vers*atile
Verus, true	*ver*, *veri*	a*ver*, *veri*ty
Vestis, a garment	*vest*	*vest*ment, in*vest*
Vetus, vetĕris, old	*veter*	*veter*an
Via, a way	*via*, *vi*	ob*via*te, ob*vi*ous
Vicinus, a neighbour	*vicin*	*vicin*ity
Video, I see, visus, seen	*vid*, *vis*	pro*vid*e, *vis*ible
Vigil, watchful	*vigil*	*vigil*ant
Vinco, I conquer, victus, conquered	*vinc*, *vict*	in*vinc*ible, *vict*ory
Vindex, vindĭcis, a claimant, a defender, an avenger	*vindic*	*vindic*ate, *vindic*tive
Viscus, viscĕris, a bowel	*viscer*	*viscer*al
Viscus, birdlime	*visc*	*visc*ous
Vita, life	*vit*	*vit*al
Vivo, I live	*viv*	*viv*id, sur*viv*e
Voco, I call, vocātus, called	*voc*, *vok*, *vocat*	irre*voc*able, re*vok*e, *vocat*ive
Volo, I will, I wish	*vol*	*vol*untary, bene*vol*ent
Volo, I fly	*vol*	*vol*atile
Volvo, I roll, volūtus, rolled	*volv*, *volut*	re*volv*e, re*volut*ion
Voro, I devour	*vor*	*vor*acious, carni*vor*ous
Vox, vocis, the voice	*voc*, *voci*	*voc*al, *voci*ferous
Vulcānus, Vulcan, the god of fire	*volcan*	*volcan*ic
Vulgus, the rabble	*vulg*	*vulg*ar, di*vulg*e
Vulsus, pulled	*vuls*	con*vuls*ion
Zona, a belt or girdle	*zon*	*zon*e

IV. GREEK ROOTS WITH THEIR ENGLISH REPRESENTATIVES.

Root and Meaning.	Representative.	Example.
Adelphos, a brother	*adelph*	phil*adelph*ia
Aethlos, a combat	*athlet*	*athlet*ic
Agōgos, a leader	*agogu*	dem*agogu*e
Akouo, I hear	*acous*	*acous*tics
Aner, andros, a man	*andria*	di*andria*
Angello, I bring tidings	*angel*	ev*angel*ist
Anthos, a flower	*antho*	*antho*logy
Anthrōpos, a man	*anthrop*	phil*anthropy*
Arché, beginning, sovereignty	*arch*	hept*archy*, *arch*bishop
Arctos, a bear, the north	*arct*	*arct*ic
Aristos, best	*aristo*	*aristo*crat
Arithmos, number	*arithm*	*arithm*etic
Arōma, aromătis, odour	*aromat*	*aromat*ic
Artos, bread	*arto*	*arto*carpus
Asphaltos, bitumen	*asphalt*	*asphalt*ic
Asthma, breath	*asthma*	*asthmat*ic
Astron, a star	*astro*	*astro*nomy
Atmos, vapour	*atmo*	*atmo*sphere
Autos, self	*auto*	*auto*graph
Bapto, I dip	*bapt*	*bapt*ism
Baros, weight	*baro*	*baro*meter
Biblion, a book	*biblio*, *bibl*	*biblio*graphy, *Bibl*e
Bios, life	*bio*	*bio*graphy
Bolbos, an onion	*bulb*	*bulb*ous
Bolé, a casting or throwing	*bolé*. *bola*, *ble*	hyper*bole*, para*bola*, par*able*
Chalyps, chalȳbos, steel	*chalyb*	*chalyb*eate
Charis, charĭtos, grace, love	*char*, *charit*	eu*char*ist, *charity*
Cheir, the hand	*chir*	*chir*ography
Chilioi, a thousand	*chili*	*chili*ad
Cholé, bile	*cholé*	*chole*ric
Chroma, colour	*chroma*	a*chromat*ic
Chronos, time	*chrono*	*chrono*meter
Chrysos, gold	*chryso*	*chryso*lite
Daktȳlos, a finger	*dactyl*	*dactyl*
Deka, ten	*deca*	*deca*logue
Demos, the people	*dem*, *demo*	epi*dem*ic, *demo*cracy
Dendron, a tree	*dendr*, *dendron*	*dendr*itic, rhodo*dendron*
Despŏtes, a lord or master	*despot*	*despot*ic
Doxo, I will think; dedogmai, I have been judged; doxé, an opinion	*dox*, *dogma*	ortho*dox*, *dogma*tize
Dromos, a course	*drom*	hippo*drome*, *drom*edary
Drus, an oak	*dru*, *dry*	*dru*id, *dry*ad
Dynămis, power	*dynam*	*dynam*ics
Ecleipo, I fail	*eclip*	*eclip*tic, *eclip*se
Eidos, a form	*eido*	kal*eido*scope
Eiron, a dissembler	*iron*	*irony*

Root and Meaning.	Representative.	Example.
Epitŏmé, an abridgment	*epitom*	*epitom*ize
Epos, a word	*ep*	*ep*ic, ortho*epy*
Erēmos, a desert	*erem*	*erem*ite (hermit)
Ergon, work	*erg*, *urg*	en*erg*etic, metall*urgy*
Ethos, a custom	*eth*	*eth*ical
Eu, well	*eu*, *ev*	*eu*logy, *ev*angelist
Gala, galaktos, milk	*galax*	*galaxy*
Gamos, a marriage	*gam*	bi*gamy*
Gaster, the belly	*gastr*	*gastr*ic, *gastr*onomy
Gé, the earth	*geo*	*geo*graphy
Geno, I produce	*gen*	oxy*gen*, hydro*gen*
Genos, kind or race	*gen*	hetero*gen*eous
Glossa, glotta, the tongue	*gloss*, *glot*	*gloss*ary, poly*glot*
Glypho, I carve	*glyph*	hiero*glyph*ic
Gonia, a corner, an angle	*gon*	poly*gon*
Gramma, a letter, writing	*gram*, *gramma*	epi*gram*, *grammar*
Grapho, I write, graphé, a writing	*graph*	auto*graph*, hydro*graphy*
Gynè, a woman	*gyn*	mono*gyn*ia, miso*gyn*ist
Gyros, a circle	*gyr*	*gyr*ation
Hagios, holy	*hagio*	*hagio*graphy
Hecăton, a hundred	*heca*	*heca*tomb
Helios, the sun	*helion*	ap*helion*
Hemĕra, a day	*hemer*	ep*hemer*al
Hemĭsus, half	*hemi*	*hemi*sphere
Hepta, seven	*hepta*	*hepta*gon
Hetĕros, dissimilar	*hetero*	*hetero*dox
Hex, six	*hexa*	*hexa*gon
Hiĕros, holy	*hier*	*hier*archy
Hippos, a horse	*hippo*	*hippo*potamus
Hodos, a way	*od*	ex*od*us
Homīlos, an assembly	*homil*	*homily*
Homos, similar	*homo*	*homo*logous
Hyălos, glass	*hyal*	*hyal*ine
Hydor, water	*hydro*	*hydro*statics
Hygros, wet	*hygro*	*hygro*meter
Ichthys, a fish	*ichthy*	*ichthy*ology
Isos, equal	*iso*	*iso*perimetrical
Kakos, bad	*caco*	*caco*phony
Kalos, handsome	*kal*	*kal*eidoscope
Kalypto, I cover, kalypso, I will cover	*calypt*, *calyps*	apo*calypt*ic, apo*calyps*e
Kalyx, a rosebud, a cup	*calyx*	*calyx*
Kardia, the heart	*cardi*	peri*cardi*um
Karpos, fruit	*carpus*	arto*carpus*
Kauso, I will burn	*caust*, *caut*	*caust*ic, *caut*erize
Kephălè, the head	*cephal*	hydro*cephal*us, *cephal*ic
Kosmos, the world, order	*cosm*	micro*cosm*, *cosm*etic
Kratos, strength	*crac*, *crat*	aristo*crac*y, aristo*crat*ic
Kyklos, a circle	*cycl*	epi*cycl*e
Kyon (cyon), a dog	*cyn*	*cyn*ic
Laos, the people	*lai*	*lai*ty
Lithos, a stone	*litho*, *lit*	*litho*graphy, chryso*lit*e
Logos, a word, description	*logo*, *logy*, *logu*	*logo*machy, chrono*logy*, cata*logu*e
Machè, a fight	*mach*	nau*machy*
Mania, madness	*mania*	*mania*c, biblio*mania*

Root and Meaning.	Representative.	Example.
Martyr, a witness	*martyr*	*martyr*ology
Mathētes, a scholar	*mathe*	*mathe*matics
Mechanão, I invent	*mechan*	*mechan*ic
Melan, black	*melan*	*melan*choly
Metron, a measure	*metr*, *meter*	geo*metr*y, thermo*meter*
Micros, little	*micro*	*micro*scope
Misos, hatred	*mis*	*mis*anthrope
Monos, alone	*mono*	*mono*syllable
Morphè, shape	*morph*	meta*morph*osis
Mythos, a fable	*mytho*	*mytho*logy
Naus, a ship	*naut*	*naut*ical
Nekros, dead	*necro*	*necro*mancy
Neos, new	*neo*	*neo*logy
Nesos, an island	*nesus*	Pelopon*nesus*
Nomos, a law	*nom*	astro*nom*y
Nosos, sickness	*noso*	*noso*logy
Odè, a song or poem	*ode*, *od*, *ed*	ep*ode*, epis*ode*, mon*od*y, com*ed*y
Oikeo, I dwell	*oeci*, *ochi*	ant*oeci*, peri*oeci*, par*ochi*al
Oikos, a house	*eco*	*eco*nomy
Olĭgos, little, few	*olig*	*olig*archy
Ophis, a serpent	*ophi*	*ophi*ology
Optŏmai, I see	*opti*	*opti*cal
Ornis, ornīthos, a bird	*ornitho*	*ornitho*logy
Orthos, right	*ortho*	*ortho*graphy
Oxys, acid	*oxy*	*oxy*gen
Pais, paidos, a boy	*ped*	*ped*agogue
Pathos, feeling	*path*	a*path*y, anti*path*y
Penté, five	*pent*	*pent*agon
Petra, a stone	*petra*, *petri*	*petra*logy, *petri*faction
Phagein, to eat	*phag*	anthropo*phag*i
Phaino, I show, I appear	*phan*, *phen*, *fan*	*phan*tom, *phen*omenon, *fan*tasy, *fan*cy
Phemi, I speak	*phem*, *phas*, *phat*, *phet*, *phec*	blas*pheme*, em*phas*is, em*phat*ic, pro*phet*, pro*phec*y
Philos, a friend	*philo*, *phil*	*philo*sophy, *phil*anthropy
Phobeo, I terrify	*phob*	hydro*phob*ia
Phonè, the voice	*phon*	eu*phon*y
Phren, the mind	*phren*	*phren*ology, *phren*zy,
Phthongos, a sound	*phthong*	di*phthong*
Physis, nature	*phys*	*phys*ical
Polĕmos, war	*polem*	*polem*ical
Poleo, I sell	*pol*	biblio*pol*e
Polis, a city	*polis*	metro*polis*
Polys, many	*poly*	*poly*gon
Potămos, a river	*potamus*	hippo*potamus*
Pous, podos, the foot	*pus*, *pod*	poly*pus*, anti*pod*es
Presbutĕros, older	*presbyter*	*presbyter*ian
Pseudo, I deceive	*pseudo*	*pseudo*-apostle
Pteron, a wing	*ptera*	a*ptera*
Sarks, sarkos, flesh, the body	*sarco*	*sarco*phagus
Sbestos, extinguishable	*sbestos*	a*sbestos*
Sitos, corn, food	*sit*	para*sit*e
Skopco, I see	*scop*	tele*scop*e

Root and Meaning.	Representative.	Example.
Sophos, wise	*soph*	*soph*ist, philo*sophy*
Stasis, a standing	*stas*, *stat*	ec*stasy*, ec*stat*ic
Stello, I send	*stle*, *stal*	apo*stle*, peri*stal*tic
Strepho, I turn	*streph*	peri*streph*ic
Telè, distant	*telè*	*tele*scope
Technè, art	*techn*	*techn*ical
Thapto, I bury	*taph*	epi*taph*
Theoreo, I see	*theor*	*theory*
Theos, God	*the*, *thus*	a*the*ist, en*thus*iast
Thermos, warm	*thermo*	*thermo*meter
Tithēmi, I put, I suppose; thesis, a position	*thesis*, *thet*	hypo*thesis*, hypo*thet*ical
Topos, a place	*topo*	*topo*graphy
Zoon, an animal	*zoo*, *zo*	*zoo*logy, a*zo*te

THE END.

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